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EHABILITATION OF NEWLY-ORMED OVER-BURDEN AT OPEN-AST MINES OF BINA COAL MINES F UTTAR PRADESH

PHOTO - SHYAM LAL

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TEAK SEED IMPROVEMENT - ACHIEVEMENTS AND PROBLEMS

ANMOL KUMAR

Maharashtra Van Sanshodhan Sanstha, Chandrapur.

Introduction

In the present period of environmental crisis great emphasis has been given to large scale plantations by both Govt. and Non-Govt. agencies. Raising successful plantations is the most important tool in the hands of foresters to avert the environmental disaster. 'Teak' has been one of the most favoured species of foresters all over the country for its superlative qualities as timber and its hardiness in the field along with better growth rate than other local species. Even as on today teak remains one of the major species in plantation in Maharashtra which has about 65000 ha/ annum of plantation targets under different schemes. Naturally huge quantities of quality seed are required to raise successful plantation. Importance of quality seed in raising teak plantations has been realised by Forest Department of Maharashtra State long back and systematic approach was worked upon as early as in 1969, by State Forest Department.

Methodology

There are two main approaches which are followed in Maharashtra for Teak Seed Improvement programme.

(a) To raise clonal seed orchards.
(b) Establishment of Teak seed production areas in natural forest.

(a) *Raising of Clonal Seed Orchard* : It involves mainly 3 steps. Firstly - Identification of Plus trees; secondly, establishing Germ Plasm Bank; thirdly, establishing Bud Multiplication Garden and fourthly, establishment of Seed Orchard. In all the above steps the common activity is development of vegetatively propagated seedling or clones from original plus tree/stock so that there is no genetic change in original germ plasm.

The most suitable method developed in Maharashtra Van Sanshodhan Sanstha for this purpose is grafting i.e. bud grafting on teak stump. This method is also called patch budding/patch grafting. Branches having suitable buds are collected from the desired tree or clone. Buds are removed from the branch by patch remover, woody portion is removed, and now bud is ready for grafting Stocks used for grafting are stumps of thumb thickness obtained freshly from one year old teak nursery bed. All lateral roots are trimmed. A patch of bark of the same size as that of bud is removed from stock just above the collar with same patch remover. Bud patch is then fitted in this incision on the stump and tied tightly with the help of polythene tape and then with sutli in such a way that bud is not covered. This bud is marked with red paint on upper and lower side so as to distinguish from other buds if sprouted. The upper end of stump is covered with a thin layer of paraffin wax to avoid loss of moisture. Budded stump is then

planted in polythene bags already filled with fertile soil. September, October, November and then March to April are the best months for budding to get high percentage of success i.e. more than 60%.

(1) *Identification of Plus trees* : The first step of seed improvement programme is selection of plus trees on the basis of superior morphological characters i.e. predominant height and diameter, clear bole, strong apical dominance, lack of knots, flutes etc. Thirty two such trees have been selected in the State located in different parts. Propagation from such trees has been done vegetatively by the method described above.

(2) *Establishment of National Germ Plasm Bank* : It is an assemblage of genetically superior (Plus trees) trees/clones from all over the country. Main objectives of N.G.P.B. were - (i) To pool all the genetically superior clones at one place and to make them available for future propagation, (ii) To study the flowering and fruiting behaviour of different clones with a point of view of identifying most suitable clones for this area, (iii) To see the growth pattern of different clones. It was established in Lohara over 2.3 ha in 1979. Three rammets of each clone were planted at a spacing of 8m x 8m. As on today there are 231 clones of all States. Statewise details of clones are as follows :

States	No. of clones
Andhra Pradesh	40
Kerala	10
Orissa	46
Tamil Nadu	19
M.P.	7
Maharashtra	29
Karnataka	45
U.P.	14
All India	14
Gujarat	4
Arunachal Pradesh	3
Total	231

Out of these 167 clones were introduced from 1979 to 1984 and 64 clones were introduced later.

(3) *Teak Bud Multiplication Garden*: Establishment of bud multiplication garden is another step in establishing TSO. It is again an assemblage of genetically superior clones with the sole objective to produce scion material of superior clones for bud grafting in a sufficiently large quantity to step up the programme of establishing teak seed orchards. The work was started in 1979 and as on today 221 clones have been introduced in Bud Multiplication Ga den. It provides continuous supply of buds for grafting.

(4) *Teak Clonal Seed Orchard* : A clonal seed orchard is a plantation of genetically superior clones which are raised through vegetative method/propagation from the original stock. It is managed intensively to produce abundant teak seed.

A spacing of 8m x 8m is used for raising seed orchards. Plantation design is as per scattered diagram to have maximum randomisation of the rammets. Planting is done in pits of size of 45cm x 45 cm filled with cowdung manure, good earth and 50 gm of 10% BHC. Intensive working in TSO is done for five years which includes soil working, manuring, weeding, cleaning and irrigation etc. Total 166.5 ha of clonal seedling seed orchards have been successfully raised by Maharashtra Van Sanshodhan Sanstha.

(b) *Teak Seed Production Area* : As it is not possible to meet the demand of seed by clonal seed orchard, another approach adopted for obtaining good seed is to find and demarcate promising teak areas which are having middle age crop of good and straight bole, predominant height and

diameter, good apical dominance and other promising morphological characters. Seed from such area is collected and tested in the laboratory for size, hollowness, viability and germination percentage. When these criterion are satisfied such areas are declared teak seed production areas and are properly maintained. As on today 306.5 ha is under teak seed production area in South and North Chandrapur circles.

Results

With such a large area under clonal teak seed orchards, seed production area etc. efforts were made to study - Flowering Behaviour, Seed production, and Seed qualities. Some of the observations are described below.

(1) *Flowering Behaviour* : Over the years data on flowering behaviour of different clones at different ages has been observed and studied. There has been large variation in initiation of flowering at different ages. Recorded observation shows that in National Germ Plasm Bank where 119 clones were established in 1979 with 3 rammets of each, flowering pattern have been very-very peculiar. Table 1 shows the flowering behaviour of all clones. All three rammets of clone MHAL-P9, MHAL-A4 and MHAL-P8 flowered in 1980, 81 and 82 respectively, on the other hand MHAL-A3, MHAL-J1 and MHAL-P5 could initiate flowering only in 1989 and that too not in all rammets as shown in the table. MHAL-A5, 6, 7, and 8 flowered between 85 and 88 but again not all rammets flowered. Thus there is a wide range of period for required for flower initiation even in the local clones.

Now if we see flowering pattern of clones obtained from outside of State, clone ORPB-19 (Orissa) flowered in 1982 with all the three rammets while another clone from Orissa i.e. ORPB-6 could flower only in 1990. Of course ORPB-15 and ORANP-1 flowered in 1988 and 1987. Another favourable pattern was shown by clones from Andhra Pradesh. Clone APKEA-24 flowered in 1981 with all rammets followed by APT-20, APT-8, APT-7 in 1982. APNLP-1 and APKEN-1 in 1983 and APT-14 and 4 in 1984. Clones from Tamil Nadu i.e. TNT-17 flowered in 1982 while other clones like TNT-18, TNT-9, TNT-2 could flower in 1990 only. TNT-14 flowered in 1987.

Clones from Kerala KLS-2 flowered only in 1990 while from Uttar Pradesh UP-D flowered (all 3 rammets) in 1988 while UP-E could flower in 1990 only (only one rammet). Karnataka clones too showed late flowering i.e. MYHD-3 in 1987, MYHU-5 and MYSA-1 in 1990. First three clones of Maharashtra have flowered continuously while 4th clone i.e. MHSC - A3 has not flowered at all. MHAL-A2 flowered in last three years only while MHAL-A1 could flower only in 1990. Among outside clones best performance has been shown by APT-20 followed by ORANP - 3 and ORTEK-1. Rest of the clones have flowered very sparingly only once in 5 years or have not flowered at all.

All the local clones show 70% and above flowered rammets in oldest seed orchard i.e. 1979 TSO. In later years pattern is not uniform. In younger TSOs (1982 to 1985) percentage of flowering is even lesser though clones like MHAL-6 and MHAL-A8 shows 60.7% and 65% flowering in 1983 TSO. In 1982 TSO MHAL-8 shows 76% flowering. Other local clones in TSO 1982-85 show 1.2 to 38% flowering. Thus flowering behaviour of teak clones appears to be very erratic showing great individual variation. But largely age factor appears to be vital one.

Table 1

Flowering initiation in clones of other States
(National Germ Plasm Bank)

Clone	Rammets			Planting Year	Year of 1st flowering
	1	2	3		
MHAL-A4	+	+	+	1979	1981
MHAL-P9	+	+	+	1979	1980
MHAL-P8	+	+	+	1979	1982
MHAL-A3	+	+	-	1979	1989
MHSC-J1	+	-	-	1979	1989
MHAL-P5	+	+	-	1979	1989
MHAL-A7	+	+	+	1979	1988
MHAL-A5	+	+	-	1979	1987
MHAL-A6	+	+	+	1979	1985
MHAL-A8	+	+	-	1979	1985
ORPB-19	+	+	+	1979	1982
ORPB-6	+	+	+	1979	1990
ORPB-15	+	+	+	1979	1988
ORANP-1	+	-	-	1979	1987
APKEA-24	+	+	+	1979	1981
APT-20	+	+	+	1979	1982
APT-8	+	+	+	1979	1982
APT-7	+	+	+	1979	1982
APNLP-1	+	+	+	1979	1983
APKEN-1	+	+	+	1979	1980
APT-14	-	+	+	1979	1984
APT-4	+	+	+	1979	1984
TNT-17	+	+	+	1979	1982
TNT-18	-	-	+	1979	1990
TNT-9	-	-	+	1979	1990
TNT-14	+	+	+	1979	1987
KLS-2	+	+	+	1980	1990
UPD	+	+	+	1982	1988
UP.E.	-	+	-	1982	1990
UP.E.	-	+	+	1982	1990
MYHD-3	+	+	-	1982	1987
MYHD-2	+	+	+	1982	1990
MYSA-1	-	-	+	1982	1990

State Symbol - MH = Maharashtra, OR = Orissa, AP = Andhra Pradesh,
TN = Tamil Nadu, KL = Kerala, UP = Uttar Pradesh,
MY = Mysore
+ = Flowered. - = Not Flowered

Few local clones have consistently shown less tendency to flower i.e. MHSC-A3, MHAL-A2, MHAL-A1 while certain local clones i.e. MHAL-P9, MHAL-A4, MHAL-P8, MHSC-A2, MHSC-A 1, LP-8 and MHSC-A3 have consistently show better flowering. Mostly outside clones were planted in Teak seed orchard from 1982 onwards. Table 2 shows that in TSO-82, APT-17 shows 57% flowering followed by ORANP-7 i.e. 47.6% minimum flowering is shown by APNPL-10. Performance of this clone has been poor in later year TSOs also. Clones no. 10 to 15 have shown nil or very scanty flowering in 1985 TSO. APT-20 of Andhra Pradesh have shown good consistent flowering. Clones from Kerala, Orissa, U.P., Karanataka have shown very scanty flowering.

Seed Production : After flowering another problem of TSO is low seed productivity. It was expected to collect 2 kg on an average/tree from 5th year onward which would reach upto 5 kg/tree upto 8th to 10th year of planting. Maximum seed production (1.098 kg/plant) is shown by MHSC-A4 in 1981 TSO. In outside clones the best performance has been by APT-8 and APMN-4 in National Germ Plasm Bank (1979) producing 2.783 and 2.553 kg/individual tree respectively. In the same year production per tree varied from 0.206 kg to 0.904 kg in 1979 TSO while in 1980 TSO has further gone down. In 1982 and 83 TSO production/plant goes to the lowest extent i.e. 0.03 kg. by APT-6. Table 2 shows that total collection of seed of TSO from 1979 to 1987 along with no. of fruited clones in 1989-90. It is clear from The table 2 that 90-100% clones have been fruited in TSO 1979, 1980, 1981 and 1982, while in TSO 1983 and 84 it is hardly 50% even in their 6th and 7th year of existence. On the other hand National Germ Plasm Bank which shows highest assemblage of clones shows minimum percentage of fruited clones and grafts i.e. 30.7% and 26.27%. TSO of 1985, 1986 and 1987 could not produce any seed. So far as the production/graft or plant is concerned it is highest in NGPB i.e. 0.921 kg followed TSO 1981 i.e. 0.410 kg. TSO 80 and 79 produce 0.367 and 0.380 kg./graft. Table 3 shows annual production of seed along with no. of fruited clones and grafts of TSO 1979, 1980 and N.G.P.B. 1979 from 1981-82 to 1989-90. In TSO 79 seed production started in 1981-82 producing only 0.10 kg increasing upto 182.500 kg in 1989-90 with 0.367 kg per plant. Though maximum no. of clones fruited is 29 out of 32 in 1988-89 but no. of grafts fruited is only 382 as against 20 clones and 497 grafts in 1989-90. On the other hand National Germ Plasm Bank shows nearly continuous increase in number of fruited clones and grafts from 1982 to 1989-90. It also shows highest seed production i.e. 134.534 kg or 0.921 kg per fruited graft. In TSO 1980 seed production was initiated in 1982 -83 reaches to highest in 1989-90 i.e. 183.662 kg or 0.455 kg/fruited graft. In 1985-86 both no. of clones and grafts flowered was reduced than the preceding year.

Thus Table 2 and 3 show that with increase in age of Teak seed orchard production of seed is increased along with a more stable flowering and fruiting pattern. And only after about 10 years or more a proper pattern of regular seed production may emerge. Simultaneously it shows, that more production of seed may be expected from older teak seed orchard but it need not follow continuous increasing yield pattern. At the same time it proves that expectation of production 2 kg/graft and 5 kg/graft in 5th and later years in TSO is too high.

Superiority of Clonal seed orchard seed: Superiority of clonal seed over general seed has been known all over. In teak main

Table 2

Information about Teak Seed Production from Teak Seed Orchards in Lohara Research Centre 1989-90

Year of formation	Area	Clones planted	No. of grafts planted	No. of grafts surviving	No. of clones fruited in 1989-90	No. of grafts fruited	Total seed collection (kg)	Seed production per fruited graft (kg)
T.S.O. 1979	5.00	30	780	772	28	497	182.500	0.367
T.S.O. 1980	6.00	22	946	927	22	483	183.622	0.38
T.S.O. 1981	8.00	24	1162	1127	23	202	82.910	0.410
T.S.O. 1982	5.50	40	847	813	32	106	21.840	0.206
T.S.O. 1983	12.50	70	1962	1898	32	210	26.990	0.128
T.S.O. 1984	15.00	30	2218	1930	14	38	2.293	0.060
T.S.O. 1985	18.00	70	2802	2427	NIL	NIL	NIL	NIL
T.S.O. 1986	14.60	65	2279	1950	NIL	NIL	NIL	NIL
T.S.O. 1987	20.00	82	3051	2563	NIL	NIL	NIL	NIL

Table 3

Year of fruiting and seed collection	T.S.O. 1979 (Area - 5 ha)					T.S.O. - 80 (Area - 6 ha)					N.G.P.B. 1979-84				
	Planted		Fruited			Planted		Fruited			Planted		Fruited		
	Total clones	Total grafts	Total clones	Total grafts	Total seed collection (kg)	Total clones	Total grafts	Total clones	Total grafts	Total seed collection (kg)	clone	grafts	clone	grafts	Total seed Collection (kg)
1981-82	30	780	3	3	0.10	22	946	-	-	-	227	681	2	4	0.110
1982-83	30	789	11	25	2.360	-do-	-do-	1	3	0.126	227	681	12	16	1.232
1983-84	-do-	-do-	22	84	6.862	-do-	-do-	4	9	0.750	227	681	13	14	2.012
1984-85	-do-	-do-	25	127	9.393	-do-	-do-	18	46	2.055	227	681	28	42	16.504
1985-86	-do-	-do-	25	96	6.419	-do-	-do-	12	20	1.335	227	681	29	45	7.536
1986-87	-do-	-do-	26	177	20.840	-do-	-do-	22	87	16.480	227	681	32	53	17.877
1987-88	-do-	-do-	29	250	NIL	-do-	-do-	22	91	NIL	-	-	55	96	NIL
1988-89	-do-	-do-	29	382	170.512	-do-	-do-	22	337	146.818	227	681	54	101	52.507
1989-90	-do-	-do-	20	497	182.500	-do-	-do-	22	403	183.662	227	681	71	146	134.534

In 1987-88 collection of seed could not be done because of storm.

critera for better seed include low or no hollowness, more no. of viable seeds, less time taken for initiation of germination and more germination percentage. Seed from 3 local clones of NGPB i.e. MHAL-P3, P8 and P9 show better and earlier germination along with lower or nill hollowness as compared to seed collected from different compett. of Dhaba teak seed production area. These observations further confirm the superiority of clonal seed over general seed.

Conclusion

Clonal Teak Seed Orchard have been raised very successfully in Maharashtra and technique of raising grafts from original germ plasm or mother trees has been standardized. But the critical part of flowering and fruiting is still far from solution. This study indicates that local clones are comparatively better for early flowering e.g. MHAL-P9, MHAL-A4, MHAL-P8, MHSC-A2, MHSC-A1 etc. Very few of outside clones have shown promising flowering behaviour e.g. APT-20, APKEA-24, ORPB-15. So far as seed production is concerned production increases with age and it may give a stabilized pattern after 10-12 years of establishment. At the same time more studies on flowering/fruiting pattern of teak have to be made correlating it with meteorological details of the area. Induction of profuse flowering in teak seed orchards is very important, which remains the first and very important bottleneck of quality seed production as flowering is affected by a number of factors mainly photo period, hormonal and nutritional balance, site factors etc. It requires more studies on hormonal balance and fertilizer effect on flowering.

Low seed production remains another problem of clonal seed orchard. But it appears that expectation of 5 kg/plant in 5th year and onwards is also too high. We may expect 2-5 kg/plant between 10th to 15th year of age of Teak seed orchard. Looking at the problems it appears that still foresters have to go a long may in solving these problems.

SUMMARY

Quality seed production is an indispensable part of successful plantation of any species. The present paper describes methods and work on teak seed improvement done in Maharashtra Van Sanshodhan Sanstha, Chandrapur. Teak seed orchards to the extent of 166.5 ha have been raised after standardization of vegetative propagation. Further flowering and fruiting behaviour of some clones at different ages has been described. Characters of teak seeds of different origins have also been discussed. It has been observed that generally flowering and fruiting increases with age of teak seed orchard. Seed from clonal seed orchards shows better germination percentage etc. than general seed.

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अनमोल कुमार

सारांश

सफल रोपवन स्थापित करने के लिए प्रत्यके वृक्ष प्रजाती के उच्च दर्जे के बीज की अत्यन्त आवश्यकता है। प्रस्तुत लेख में महाराष्ट्र वन संशोधन संस्था चंद्रपुर द्वारा सागवान के दर्जेदार बीज के उत्पादन व सुधार के लिए किए गये प्रयासों का संक्षिप्त विवरण दिया गया है। सागवान के शाकीय प्रजनन की विधी को स्थापित कर १६० हेक्टर क्षेत्र के उपर सागवान बीजोधान तैयार किए गये है। यह भी देखा गया है कि सामान्यतः उम्र के बझने के साथ फूल व बीज के उत्पादन मे वृद्धि होती है। बीजोधान के बीज कि उत्तमता को अन्य बीज की तुलना में प्रमाणित भी किया गया है।

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EXPORT OF WILDLIFE AND PRODUCTS FROM CALCUTTA PORT AN INDEPTH STUDY

KALYAN CHAKRABARTI*

Introduction

The export of wildlife and products had a chequered history. Government of India promulgated a Central Act in the name of Wild life Protection Act, 1972 for ensuring adequate conservation measures to wildlife, products and derivatives in the country. All the States are to frame their own Wildlife Rules to implement the same in various States. The export matters concerning wildlife, products and derivatives are to conform to Export Policy framed by Ministry of Commerce, Government of India from time to time. The export is further regulated through trade notices called Export (Control) Order issued from time to time by appropriate authorities in the Ministry of Commerce, Government of India.

Results and Discussion

Live Birds : Live birds occupy a very prominent position in the total export position from Calcutta both in terms of value and quantum. The analysis of export data indicates that maximum export of live birds from Calcutta has occurred during 1976 in which year only a total number of 8,02,976 live birds was exported at a total value of Rs. 10.5 million (approximately) and the minimum number of birds was however exported during 1988 when 32,692 live birds were exported at a total value of Rs. 1.2 million. Over the period of 14 years (1975 to 1988), a total of 2.3 million birds were exported at a total value of Rs. 43.6 million. As a matter of fact, the total number of birds exported from India during April 1968 to March 1969 was 43,91,882 and export to Japan contributes 13.3% followed by Italy 7.5%, France 6.8% during the same period.

From the export figures of live birds it appears that during the year 1977 birds belonging to the family Ploceidae alone accounted for 85.54% of the total export quantity. Due to sudden ban imposed on the export of Munias (family Ploceidae) from April, 1978 export of the birds belonging to the families Psittacidae, Irenidae, Muscicapidae, Zosteropidae and Emberizidae was increased significantly. Due to ban imposed on the export of the Hill Myna (*Gracula religiosa*) the export of the birds belonging to the family Sturnidae declined considerably. The said ban on Ploceidae was however lifted subsequently from 1980. The export ban was however in operation from 1983 in respect of families Irenidae, Muscicapidae, Zosteropidae and the same was reflected in export trend. The export situation in respect of various components of wildlife and products from 1975 to 1988 is presented in Table 1 which exhibits the year to year export both in

* Regional Deputy Director, Wildlife Preservation, Eastern Region, Calcutta (West Bengal).

Table 1

Export of wildlife and its products from Calcutta Port during the year 1975 to 1988.

	Total			Value
	Number	Kg.	Flasks	(Rs.)
Live Birds	23,73,161	-	-	4,36,75,822
Live Mammals	4,665	-	-	13,13,949
Porcupine Quills	23,66,286	-	-	10,42,208
Peacock Tail Feathers	64,50,475	-	-	24,83,626
Snake skins	28,32,304	-	-	2,03,54,825
Frog-legs	-	20,43,071	-	3,16,40,755
Stag horns	9	88,180		24,03,830
Turtle/Tortoise shells	-	17,280	-	73,441
Jungle Cat Skin	21,150	-	-	8,47,664
Jackal Skin	72,435	-	-	1,22,79,333
Jackal Skin Products	4	-	-	12,000
Indian Fox Skin	13,000	-	-	6,15,591
Ivory Products	2	42	-	1,14,132
Fishing Floats				
M/o. Peacock Feathers	-	8	-	6,409
Reptiles/Turtles	138	-	-	2,109
Lizard skins	4,79,420	-	-	21,47,856
Orchids	5,77,188	2,015	31	46,64,492
Plant derivatives	-	4,54,.094	-	90,41,338
Trocus shells	-	78,058	-	14,04,980
Total				13,41,24,360

quantity and value.

It was observed further that out of the total export of Munias 34.92% was artificially dyed during the year 1977 and 40.89% during the year 1978. But considering the ill effect of the practice of artificial dying of birds, Govt. of India had imposed a ban on such practice since then. Thereafter, there had been no cases of artificial dying of birds.

The percentage of total export of living birds to different countries had been computed yearwise and is appended in Table 2. From this table it is observed that Japan tops the list of importing countries every

Table 2

Percentage of Live Birds exported to different countries through Calcutta Port from 1977 to 1988.

Country	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Japan	58.35	52.04	42.5	27.7	47.72	34.85	52.9	39.0	23.0	21.25	47.36	67.3
Holland	21.24	5.75	1.75	13.87	9.0	28.21	21.28	9.0	18.25	12.0	7.47	5.8
Belgium	1.20	2.37	0.53	-	0.8	3.06	2.7	7.5	8.21	9.7	0.8	7.8
Taiwan	3.28	11.13	27.0	18.35	22.78	26.02	-	-	-	-	-	-
West Germany	3.59	9.64	4.8	16.8	4.8	3.85	8.8	7.5	9.55	5.32	5.06	1.5
Italy	0.09	5.82	11.93	6.5	1.6	-	0.8	3.0	2.9	-	11.31	6.6
Hongkong	2.48	5.28	3.60	5.45	0.7	1.16	-	12.0	17.53	30.0	0.8	-
Singapore	-	-	-	-	-	-	2.78	16.0	0.8	4.63	6.28	-
France	7.03	0.65	1.84	-	6.25	-	8.4	3.5	6.0	12.5	-	-
Spain	2.24	3.91	2.46	8.13	4.5	-	-	-	-	-	-	-
Malaysia	-	-	-	-	-	-	-	-	3.55	-	9.5	8.0
USA	-	0.95	-	-	-	2.85	1.3	-	5.6	-	0.06	-
UK	0.43	1.70	1.47	-	1.85	-	0.8	-	0.75	02.003	0.3	-
Greece	-	0.29	0.95	1.6	-	-	-	0.5	3.6	3.81	4.83	2.3
Bangladesh	-	-	-	-	-	-	-	-	-	0.25	1.4	-
Switzerland	-	-	-	-	-	-	0.24	-	0.26	-	-	-
Denmark	0.01	0.09	-	0.7	-	-	-	-	-	-	-	-
Austria	-	0.38	0.7	0.9	-	-	-	-	-	-	-	-
U.A.E.	0.06	-	-	-	-	-	-	2.0	-	-	-	-
Nepal	-	-	0.47	-	-	-	-	-	-	-	-	-
Portugal	-	-	-	-	-	-	-	-	-	0.54	2.83	0.7
Phillipines	-	-	-	-	-	-	-	-	-	-	2	-

year though with varying intensity. Amongst the birds under CITES, Alexandrine parakeet occupies the topmost position. From 1977 to 1988 as many as 65,465 numbers of Alexandrine parakeets had been exported through Calcutta Airport alone. Next comes Red breasted parakeets and Blossom headed parakeets and the export figures of these species during 1977 to 1988 (twelve year period) stand as 41,453 numbers and 20,186 numbers respectively. The following bird species included under CITES were exported. The total number of birds exported during 1977 to 1988 from Calcutta (1,27,773) are also given against each bird species.

Name of species	Number exported from Calcutta (1977 to 1988)
Allexandrine parakeet	65,465
Red breasted parakeet	41,453
Blossom headed parakeet	20,186
Slaty headed parakeet	320
Fischer's love bird	194
Moustache parakeet	100
Peached faced love bird	24
Sarus crane	17
Blyth's Tragopan	4
Blue winged parakeet	6
Nicobar pigeon	2
White winged wood duck	2

The total number of live birds exported during 1975 to 1988 (14 years) is about 2.4 million at a total value of Rs. 43.6 million.

Export of Wildlife Products other than Live Birds : An analysis of various components of export from Calcutta Airport and Seaport from 1975 to 1988 indicates that there are a large number of items included in export of wildlife and products. The item include live birds, live mammals, porcupine quills, peacock tail feathers, snake skins, frog legs, stag horns, turtle/tortoise shells, jungle cat skins, jackal skins, jackal skin products. Indian fox skins, Ivory products, fishing floats made of peacock feathers, reptiles/ turtles, lizard skins, plant derivatives and orchids etc.

All these exports had been drastically regulated because of promulgation of amendment in Wildlife Act, revision in Export Policy and strict enforcement of Convention of International Trade on Endangered Species. The last export on snake skins from Calcutta Port was made during 1979 and thereafter no export was made from Calcutta Port. Similarly, CITES regulation was enforced in respect of Frog-legs from 1985 onwards and the export of Froglegs was also banned from 1st April, 1987 in terms of Export Policy. As regards Orchids, a fresh export control was effected from 1st April, 1988 wherein only the cultured orchids contained in flasks are only allowed. This had also helped in building nature conservation as no wild orchids could now be exported from India.

The total quantum of export of live mammals, specieswise are given in Table 3 yearwise from 1977 to 1988. It appears from the same that only the family Pteropidae is exported regularly in varying intensity while other species do not figure in exports.

The percentage in export of plant derivatives from 1980 to 1988 to different countries is given in Table 4. It appears from the table that during 1980, USA (76.3%) was the prime country of import in respect of plant derivatives but this position was virtually lost over the years. During 1988, Italy tops the list of importing countries so far as plant derivatives is concerned contributing to 33.5% of all exports of plant derivatives from Calcutta Port. During 1987,

Table 3

Quantity of export of Live Mammals from Calcutta Port during 1977 to 1988.

Name	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	2	3	4	5	6	7	8	9	10	11	12	13
Flying Fox (*Pteropus giganteus* B.)	150	302	50	-	52	55	91	102	30	40	100	35
Assamese Macaque (*Macaca assamencis* M.)	115	-	-	-	-	-	-	-	-	-	-	-
Common Langur (*Presbytis entellus* D.)	2	-	-	-	-	-	-	-	4	-	-	-
Bonnet Monkey (*Macaca radiata*)	-	-	-	-	-	-	-	-	4	-	-	-
Himalayan Black Bear (*Selenarctos thibetanus* C.)	15	31	-	-	-	-	-	-	-	-	-	-
Small Indian Mongoose (*Herpestes auropunctatus* H.)	17	-	-	-	-	-	-	-	-	-	-	-
Common Mongoose (*Herpestes edwardie* G.)	34	-	-	-	-	-	-	-	-	-	-	-

(Contd...)

1	2	3	4	5	6	7	8	9	10	11	12	13
Striped Palm Squirrel (*Funambulus* sp.)	450	1160	300	150	-	-	-	-	-	-	-	-
Indian Mole Rat (*Bandicota bengalensis*)	-	-	-	-	8	-	-	-	-	-	-	-
Indian Field Mice (*Mus booduga* G.)	-	-	-	-	1	-	-	-	-	-	-	-
Nilgai (*Boselaphus tragocemelus*)	-	-	-	-	-	-	-	-	2	-	-	-
Indian Rabbit (*Lepus nigricollis*)	-	-	-	-	-	-	-	-	-	-	60	-
Indian Elephant (*Elephas maximus*)	-	-	-	2	-	-	-	-	2	-	-	-
Indian Rhinoceros (*Rhinoceros unicornis* L.)	-	-	-	-	-	-	-	-	-	1	-	-
Spitz (*Canis sp.*)	-	-	-	-	-	-	-	-	-	-	16	-
White tiger (*Panthera tigris*)	-	-	-	-	-	-	-	-	-	-	-	2

Table 4

Export of Plant Derivatives (in percentage) to different countries through Calcutta Port from 1980 to 1988.

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	2	3	4	5	6	7	8	9	10
U.S.A	76.3	-	-	14.3	8.5	26.8	13.1	0.08	16.85
France	23.7	62.5	-	10	11.9	9.8	14.4	3.9	0.96
West Germany	-	25.8	-	36.6	17.6	40.4	32.3	12.2	13.15
Japan	-	11.7	-	-	1.5	1.9	-	0.4	1.7
China	-	-	-	16.3	-	-	-	-	-
Australia	-	-	-	12.7	1.2	5.2	1.1	-	0.001
U.K.	-	-	-	5.5	0.5	11.2	1.6	0.18	5.8
Holland	-	-	-	4.6	3.7	3.7	12.3	0.2	14.7
Burma	-	-	-	-	0.3	-	-	-	0.00008
New Zealand	-	-	-	-	23	0.4	-	-	-
Bangladesh	-	-	-	-	0.2	-	-	-	-
Italy	-	-	-	-	0.3	-	21.8	-	33.5
West Indies	-	-	-	-	1.6	-	-	-	-
Canada	-	-	-	-	0.1	-	1.3	-	0.0008

(Contd...)

1	2	3	4	5	6	7	8	9	10
U.A.E.	-	-	-	-	29.6	-	-	-	-
Belgium	-	-	-	-	-	0.6	-	-	0.0006
Hongkong	-	-	-	-	-	-	2.1	82.7	0.001
Taiwan	-	-	-	-	-	-	-	0.12	0.0009
Thailand	-	-	-	-	-	-	-	0.04	0.23
Singapore	-	-	-	-	-	-	-	0.18	4.6
Norway	-	-	-	-	-	-	-	-	0.0014
Portugal	-	-	-	-	-	-	-	-	0.0008
South Korea	-	-	-	-	-	-	-	-	0.001
Kenya	-	-	-	-	-	-	-	-	0.001
Switzerland	-	-	-	-	-	-	-	-	0.00082
Spain	-	-	-	-	-	-	-	-	0.0006
Denmark	-	-	-	-	-	-	-	-	1.2
Mexico	-	-	-	-	-	-	-	-	1.8
Sri Lanka	-	-	-	-	-	-	-	-	1.3
Pakistan	-	-	-	-	-	-	-	-	4.2

Hongkong contributed 82.7% of all exports of plant derivatives and during 1986 West Germany with 32.3% of import has dominated the import situation of plant derivatives. West Germany maintains more or less a steady import situation with percentages of 40.4, 17.6, 36.6 and 25.8 during 1985, 1984, 1983 and 1981 respectively.

The percentages of export of porcupine quills, peacock tail feathers, Trocus shells, snake skins, Ivory products, Stag horns to different countries from 1977 to 1988 are given in Table 5. Regarding Peacock tail feathers, the principal country of import is Japan contributing to percentages 72.3, 68.7, 69.2, 73.4, 40.4 and 62.3 during 1988, 1986, 1985, 1983, 1982 and 1981 respectively while France, USA and some other countries also contributed in import in some measure over the years. Japan, West Germany and USA also contributed significantly moreover other countries in respect of import of live mammals. It may be mentioned in this connection that the import/export of live mammals is mainly zoo to zoo transaction. The last export of Trocus shells, Stag horns and Ivory products from Calcutta Port was made in the years 1985, 1981 and 1985 respectively.

Conclusion

When any fauna is transferred from one locality to another there is potential for significant biological consequences both at the place of origin and at the place of destination. It is obvious that exporting large numbers of wild fauna is a drain on wild populations in the country of origin, but what is not so obvious is the threat in the country of destination where endemic populations could be adversely affected by competition from introduced species. In addition consideration must be given to economic aspects when the species being imported has pest potential. Considering the onslaught on wilderness areas and their effects on faunal resources particularly the avifauna, the action of collecting and trapping of wild fauna should be given due consideration. This is further aggravated by the problem of pesticide residues. The efficacy of international trade in live birds and other fauna should be assessed in this background.

From the statistics of export over a span of 14 years (1975 to 1988) in both quantity and value, it appears that export position of wildlife and its products and derivatives follows a sharp declining trend and the total value of export in 14 years stands at Rs. 134.1 million. The maximum export value was reached during 1977 at Rs. 23.4 million and the minimum has occurred during 1980 at Rs. 1 (one) million. The trend is discernible in the sense that the export of a good number of wildlife products and derivatives had been either banned or regulated and because of stricter implementation of Export Policy, Acts, Rules and Government Orders. As the export is directly linked with foreign exchange, it may appear that this declining trend in export casts a gloom in our economy but considering the large scale impact on nature regarding capture and collection of wild specimens this trend seems to be quite in conformity with the maintenance of balance in nature. But it may be pointed out that our export policy should stand on a more scientific footing and the same should be formulated after proper inventory of the depleted population of various species of avifauna and other animals in nature. A scientifically balanced and mixture of sound economy and restoration of environmental stability is the key answer to this knotty problem.

Table 5

Percentage of some wildlife products exported through Calcutta Port to different countries Yearwise from 1977 to 1988.

Country	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	2	3	4	5	6	7	8	9	10	11	12	13
Porcupine Quills:												
West Germany	-	10	41.6	-	-	-	-	-	1.4	89.4	-	-
France	58.75	68.3	38.7	100	100	-	-	-	-	-	-	-
U.K.	-	5.6	5.5	-	-	-	4.7	-	80.7	-	-	100
Austria	-	-	1.6	-	-	-	-	-	-	-	-	-
Belgium	-	1.7	1.9	-	-	-	-	-	-	-	-	-
U.S.A.	41.25	12.5	10.7	-	-	-	68.4	3.3	17.9	10.6	-	-
Holland	-	1.9	-	-	-	100	9.9	96.1	-	-	-	-
Australia	-	-	-	-	-	-	17	-	-	-	-	-
Peacock Tail Feathers:												
W. Germany	9.4	16.5	40.6	15.9	-	-	-	-	-	-	31	-
France	9.5	31.1	40.6	-	-	-	-	-	-	10.6	-	27.7
U.S.A	47.1	21.2	17.2	12.7	-	8.1	-	-	30.8	-	17.8	-
Holland	-	-	1.6	-	7.3	-	-	-	-	-	-	-
U.K.	-	-	-	63.7	-	-	25.1	-	-	-	-	-
Denmark	8.4	-	-	7.7	-	-	-	-	-	-	-	-
Belgium	-	9.2	-	-	3.34	50	-	-	-	-	-	-
Australia	-	-	-	-	2.05	-	-	-	-	19	-	-
Japan	20.4	22	-	-	62.3	40.4	73.4	-	69.2	68.7	-	72.3
Singapore	-	-	-	-	25.1	-	-	-	-	1.7	-	-

(Contd....)

1	2	3	4	5	6	7	8	9	10	11	12	13
Hongkong	5.2	-	-	-	-	1.5	-	-	-	-	-	-
Taiwan	-	-	-	-	-	-	-	-	-	-	51.2	-
Kenya	-	-	-	-	-	-	1	-	-	-	-	-
S. Korea	-	-	-	-	-	-	0.5	-	-	-	-	-
Trocus Shells:												
S. Korea	-	-	-	-	-	-	-	-	100	-	-	-
Ivory Products:												
U.S.A.	-	-	-	-	-	-	-	-	100	-	-	-
Stag Horn:												
W. Germany	24.1	50	100	-	65.6	-	-	-	-	-	-	-
Italy	75.9	18.8	-	-	-	-	-	-	-	-	-	-
France	-	31.2	-	-	-	-	-	-	-	-	-	-
U.S.A.	-	-	-	-	1.6	-	-	-	-	-	-	-
U.K.	-	-	-	-	32.8	-	-	-	-	-	-	-
Snake Skins:												
U.K.	26.81	-	100	-	-	-	-	-	-	-	-	-
West Germany	32.43	-	-	-	-	-	-	-	-	-	-	-
France	4.01	-	-	-	-	-	-	-	-	-	-	-
Spain	8.80	-	-	-	-	-	-	-	-	-	-	-
Italy	19.61	-	-	-	-		-	-	-	-	-	-
U.S.A.	8.34	-	-	-	-	-	-	-	-	-	-	-

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SUMMARY

Like any other activity export of wildlife and products also had seasonal and cyclic fluctuations. There are booms and slumps in export activities as well. The analysis of export statistics on wildlife and products clearly indicates that the export activity was at its peak during 1977 both in respect of value and quantity except for live birds, live mammals, snake skins and turtle/tortoise shells in which cases the peak year was 1976. The significant export activity also persisted during 1978 though with diminishing amplitude. But since 1979 there was a sharp fall in export activity and then year after year export is getting drastically reduced. This is primarily because of various restrictions imposed for export on wildlife and products by the authorities. The export data collected during the years 1975 to 1988 from Calcutta Port are presented in this paper. It includes the data on export by air, sea and postal parcels. The analysis of the data brings out revealing facts on different components of export.

Japan stands out as the main country of import in respect of live birds over the period under study and is followed by countries like Holland, West Germany, Hongkong, Taiwan, Singapore, France etc. Another important dimension in export activity is the signing of an international convention namely Convention of International Trade on Endangered Species (CITES). India became member of CITES since October 18, 1976. This international convention has greatly effected an international control on export trade on wildlife and its products and paved the way for successful wildlife conservation.

कलकत्ता बन्दरगाह से वन्य प्राणियों तथा उनसे बनाई
वस्तुओं का निर्यात - एक गहन अध्ययन

कल्याण चक्रवर्ती

सारांश

अन्य कार्य-कलाप की भांति वन्य प्राणियों और उनसे बनाई वस्तुओं के निर्यात में मौसमवार और चक्रानुसारी घटी-बढ़ी होती है। इसीलिए इसके निर्यात-कलाप में भी तेजी-मंदी होती रहती है। वन्य प्राणियों और उनसे बनी वस्तुओं के निर्यात आंकड़ों के विश्लेषणों से पता चलता है कि मूल्य और मात्रा दोनों के विचार से निर्यात सक्रियता का शिखर वर्ष 1977 रहा, केवल सजीव पक्षियों, सजीव स्तनियों, सांप की खाल और कछुओं के शल्क के निर्यात को छोड़कर जिनको शिखर वर्ष 1976 में मिला यह

सार्थक निर्यात सक्रियता 1978 में भी जारी रही, यद्यपि इसके विस्तार में कुछ कमी आई। परन्तु 1979 से यह तेजी से गिरती रही और तब से वर्ष के बाद वर्ष यह निर्यात बहुत अधिक कम होता जा रहा है। इसके प्रधान कारण अधिकारियों द्वारा वन्य प्राणियों और उनसे बनाई वस्तुओं पर लगाए नाना प्रकार के प्रतिबन्ध ही है। कलकत्ता बन्दरगाह से एकत्र किए 1975 से लगाकर 1988 तक के निर्यात आंकड़ो को प्रस्तुत अभिपत्र में प्रस्तुत किया गया है। इनमें विमान, जलयान और डाक पैकेटों द्वारा किए निर्यात के आंकड़ों को लिया गया है। इन आंकड़ों के विश्लेषण से निर्यात के विभिन्न अंगों के बारे में आंखे खोलने वाले तथ्य सामने आते हैं।

इस अध्ययन की समूची अवधि के दौरान सजीव पक्षियों का आयात करने वाला प्रधान देश जापान रहा जिसके बाद हौलेण्ड, पश्चिम जर्मनी, हांककांग, ताइवान, सिंगापुर, फ्रांस इत्यादि देश आते है। निर्यात सक्रियता का अन्य महत्वपूर्ण आयाम रहा है विलोप खतरे में आई जातियों के अन्तरराष्ट्रीय व्यापार पर समाम्नाय बनना। भारत इस समाम्नाय का सदस्य 18 अक्तूबर 1976 को बना। इस अन्तरराष्ट्रीय समाम्नाय ने वन्य प्राणियों और उनसे बनाई वस्तुओं के निर्यात व्यापार के अन्तरराष्ट्रीय नियन्त्रण पर बहुत प्रभाव डाला है और वन्य-प्राणियों के संरक्षण की सफलता का पथ प्रशस्त किया है।

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DEVELOPMENT OF TECHNOLOGY FOR AFFORESTATION OF SODIC SOILS. I - LEGUMINOUS SPECIES

S.D. SHARMA, K.G. PRASAD, LAJPAT RAI* AND NARESH MALIK**

Division of Ecology & Conservation,
Forest Research Institute, Dehra Dun (India)

Introduction

In India, the forest cover is only 12.5 per cent against requirement of 33 per cent of total geographical area for maintaining optimum ecological balance. In States like Punjab and Haryana major portion of good quality available land for afforestation has already been planted. As such, the only way to increase forest cover is through afforestation of unproductive problematic wastelands. About 7.5 per cent area of 93.6 m ha wastelands is constituted by salt-affected soils and enrichment of salts is a serious impediment for establishment and growth of tree species. However, economically viable and adoptable technology for afforestation of such soils is not available.

A good amount of research work has been done on reclamation of salt-affected soils for agricultural purposes (Swarup, 1986; Tomar *et al.*, 1987). However, research on plantation of tree species on salt affected soils remained scanty and incomplete (Yadav, 1980; Gill and Abrol, 1985; Chabra and Abrol, 1986). It was, therefore, considered worthwhile to take up field experiments on afforestation of typical sodic soils of Haryana where about 5.26 lakh ha of land is occupied by salt-affected soils. This article carries an account of one of the experiments laid out in 1987 to find out suitable leguminous species and soil amelioration treatment for sodic soils.

Study Area

The experiment was laid out in rectangle 73 of Saraswati Range, Kurukshetra Forest Division of Haryana. General relief is almost flat and climate is semi-arid tropical with annual mean rainfall of 576mm. Most of the precipitation (470 mm) is received during July to September. Winter rains are scanty and irregular. Summer is very hot accompanied by hot-winds (Loo). Mean maximum and minimum temperatures during summer are 43.3 and 20.3°C. Winter temperature ranges between 26.1 and 3.1°C. Area at the time of laying out experiment was practically devoid of any vegetative cover.

Experimental

Survey of the salt-affected areas of Kurukshetra Forest Division revealed that rectangle 73 (10 ha) of Saraswati Range was typical representative site for the study. Seven soil pedons were examined at different location in the rectangle. Soil samples

* Conservator of Forests, Social Forestry, Ambala. (Haryana).
** Range Officer, Research & Training Division, Pinjore (Haryana).

were collected from the genetic horizons (Soil Survey Staff, 1951) and site features recorded. On the basis of soil analytical data (Soil Survey Staff, 1972) and site features a statistically sound split-plot design of the experiment, comprising eight treatments replicated four times, was laid out in August 1987. Treatment consisted of drainage in the main plot (D_0-without trench and D_1 with one m deep and one m wide trench throughout the length) and soil management in sub plot, (M_0 - Original soil refilled without any treatment, M_1 - Original soil refilled after mixing 5g BHC followed by application of 1 kg rice-husk as mulch , M_2 - Original soil mixed with 3 kg gypsum, 20g urea, 50 g single super phosphate, 25g muriate of potash, 5g BHC, 0.2 g zinc sulphate and 2 kg rice husk and refilled. 15g urea each was top dressed 3 and 7 months after planting and M_3-same as M_2 added with 1 kg rice husk as mulch and additional top dress with 15g urea and 1 kg rice-husk mulch after 14 months of planting).

Plots of 10m x 15m size were prepared and 25 seedlings of *Prosopis chilensis, Tamarix articulata, Acacia nilotica, Albizia lebbek* and *Pongamia pinnata* were planted in each plot at a spacing of 2m x 3m in auger holes made through tractor mounted auger (15 cm dia and 120 cm depth). Irrigation was provided twice a month during summer months and once a month in dry winter period. Replacement of dead plants was carried out for six months. Survival and height of plants were recorded 6, 12, 24 and 36 months after planting. After two years, collar circumference was also recorded. Data, thus collected, were statistically analysed.

Results

Revar soil is fine loamy, mixed, thermic family of Aquic Petrocalcic Natrustalf with poor nutrient status (Table 1). Epipedon is dry extremely hard, compact and highly dispersed resulting in impeded drainage. Presence of about 30 cm thick indurated calcareous pan at about 80 cm is another severe problem to be encounted.

Response of treatments by different species are presented below:

Tamarix articulata : Effect of treatments was seen from six months (Table 2). Survival percentage were 86 and 90% in M_2 and M_3 treatment as compared to 54% in control. Survival rate remained same even after three years of growth in M_2 and M_3 treatments whereas plants with M_0 and M_1 treatments decreased to 13% and 5% after 12 months, and all plants died after 24 months.

Average height of *T. articulata* after six months was 45cm and 50 cm in M_2 and M_3 treatments which was 126 and 151% over control (20 cm) and after one year further increased to 627 and 726% for M_3 and M_2 treatments respectively. The increase in relative height growth (RHG) due to M_2 treatment was 147, 185 and 150% after 12, 24 and 36 months respectively as compared to 6 month growth whereas in M_3 treatment the RHG was 153, 174 and 156% respectively. Further, the collar circumference after 2 years for M_2 and M_3 treatment were 5.4 and 7.1 cm, which increased to 7.1 and 8.07 cm after 3 years respectively.

Prosopis chilensis : Perusal of Table 3 brings out that number of living plants in M_2 and M_3 treated auger holes were prominently higher (98%) than those in M^o (20%) and M_1 treatments (39%) after six months. Due to replacement of dead plants, survival per centage considerably increased (47%) in M_0 and M_1 after one year but again dwindled to 12 and 28% and 4.5 and 9.5% in the second

Table 1

Physico-chemical properties of the soils of Revar Rectangle 73

Properties	Horizon			
	Ap	B21	B22t	B23 Ca
Depth (cm)	0-30	30-35	55-87	87-100
Sand (%)	54	54	62	68
Silt (%)	26	24	26	24
Clay (%)	20	22	12	8
Texture	SiL	SiL	SiL	LS
pH (1:2.5)	9.7	10.0	9.7	9.6
E.C. (ds/m) (1:2.5)	1.3	1.2	0.9	0.9
Water soluble salts (%)	0.74	0.87	0.76	0.48
Organic carbon (%)	0.36	0.34	0.08	0.08
Cation exchange capacity (m.e.%)	11.6	17.9	13.1	7.2
Exchangeable calcium (m.e. %)	2.12	1.93	2.31	1.74
Exchangeable magnesium (m.e. %)	0.69	0.52	1.03	0.61
Exchangeable potassium (m.e. %)	0.74	0.53	0.24	0.18
Exchangeable sodium (m.e.%)	6.9	11.5	7.6	3.5
Exchangeable sodium (%)	59.8	64.3	57.7	48.2
Base saturation (%)	90.08	80.89	85.34	83.75
Total nitrogen (%)	0.024	0.021	0.005	0.003
Available phosphorus (ppm)	25	25	15	20
Available potassium (ppm)	100	90	45	30
Free calcium carbonate (%)	7.2	8.0	5.2	1.9

and third year, respectively whereas almost same survival percent was noticed in M_2 and M_3 soil management treatments.

Height growth under different treatments reveals that M_2 and M_3 are certainly superior over M_o and M_1. Plants were about two fold taller (48 cm) in former than later (23 and 27 cm respectively) after six months and difference in height growth continued to be more with time. After one, two and three years height of plants were 247, 1086 and 615% more in M_2 treatment 231, 973 and 498% more in M_3 treatment, respectively than M_o treatment of same age. The collar circumference were 0.62 and 1.26 cm in M_o treatment and were 1231 and 1372% more in M_2 treatment and 631 and

Table 2

Effect of soil management treatments on survival and height of T. articulata in sodic soil

Treatment	Survival (%)					Height (cm)				
	M_0	M_1	M_2	M_3	Mean	M_0	M_1	M_2	M_3	Mean
					6 months					
D_0	53	49	96	93	72	18.95	10.03	53.40	54.62	34.25
D_1	55	34	80	87	64	21.17	11.89	37.11	45.99	29.06
Mean	54	42	88	90		20.06	10.96	45.30	50.31	
C.D. 5% for management	20.32							9.11		
					12 months					
D_0	2	D	98	93	49	11.25	D	127.15	136.70	68.78
D_1	23	10	78	85	49	19.51	17.16	112.55	117.45	16.67
Mean	13	5	88	89		15.38	8.58	111.85	127.08	67.72
C.D. 5 % for management	9.57							14.24		
					24 months					
D_0	D	D	97	94	48	D	D	136.10	156.00	73.03
D_1	D	D	78	83	40	D	D	122.31	120.09	60.60
Mean	D	D	88	89		D	D	129.20	138.05	
C.D. 5% for management	9.51							11.67		
					36 months					
D_0	D	D	97	94	48	D	D	123.4	152.8	69.05
D_1	D	D	73	83	44	D	D	103.6	104.8	52.10
Mean	D	D	85	88.5		D	D	113.5	128.8	
C.D. 5% for management	10.62							29.27		

D = Dead

Table 3

Effect of soil management treatments on survival and height of P. chilensis in sodic soils

Treatment	Survival (%)					Height (cm)				
	M_0	M_1	M_2	M_3	Mean	M_0	M_1	M_2	M_3	Mean
					6 months					
D_0	11	29	99	98	59.2	23.96	28.14	53.32	47.34	38.19
D_1	29	49	97	98	68.2	21.33	25.79	43.11	50.31	35.12
Mean	20	39	98	98		22.65	26.94	48.22	48.83	
C.D. 5% for management	13.51							10.58		
					12 months					
D_0	44	51	97	98	72.5	55.53	42.04	135.18	121.26	88.48
D_1	49	42	98	97	71.5	43.14	52.31	108.62	106.24	77.58
Mean	46.5	46.5	97.5	97.5		49.34	47.18	121.90	113.75	
C.D. 5% for management	19.37							16.15		
					24 months					
D_0	10	27	99	94	57.50	18.00	75.33	234.71	187.04	128.77
D_1	14	29	95	93	57.75	18.61	48.00	162.79	168.97	99.59
Mean	12	28	97	93.5		18.30	61.67	198.75	178.01	
C.D. 5% for management			20.11					52.01		
					36 months					
D_0	6	5	98	94	50.75	24.80	27.70	266.70	209.00	132.05
D_1	3	14	93	93	50.75	51.70	55.40	203.70	172.20	120.75
Mean	4.5	9.5	95.5	93.5		38.25	41.55	235.20	190.60	
C.D. 5% for management	13.22							92.53		

Table 4

Effect of soil management treatments on survival and height of A. nilotica in sodic soil

Treatment	Survival (%)					Height (cm)				
	M_0	M_1	M_2	M_3	Mean	M_0	M_1	M_2	M_3	Mean
					6 months					
D_0	16	5	97	99	54.3	44.19	16.69	38.22	45.47	36.14
D_1	20	24	89.5	85	54.6	36.66	40.24	49.56	41.62	42.02
Mean	18	14.5	93.2	92		40.42	28.46	43.89	43.55	
C.D. 5% for management			9.19					11.58		
					12 months					
D_0	D	D	99	93	48.0	D	D	80.65	76.71	39.34
D_1	11	10	83	83	46.8	32.17	23.91	75.31	82.10	53.37
Mean	5.5	5.0	91	88		16.09	11.96	77.97	79.40	
C.D. 5% for management			16.43					24.27		
					24 months					
D_0	D	D	99	91	47.5	D	D	96.00	91.79	46.95
D_1	D	D	80	74	38.5	D	D	85.51	86.24	42.94
Mean	D	D	89.5	82.5		D	D	90.67	89.02	
C.D 5% for management			13.72					11.10		
					36 months					
D_0	D	D	99	91	47.5	D	D	97.2	96.7	48.48
D_1	D	D	80	72	38.0	D	D	80.0	78.4	39.60
Mean	D	D	89.5	81.5		D	D	88.6	87.6	
C.D. 5% for management			24.30					18.36		

D = Dead

Table 5

Effect of soil management treatments on survival and height of P. Pinnata under sodic soils

Treatment	Survival (%)					Height (cm)				
	M_0	M_1	M_2	M_3	Mean	M_0	M_1	M_2	M_3	Mean
					6 months					
D_0	79	80	98	84	85.2	27.48	29.12	32.25	25.82	28.67
D_1	86	88	95	95	91.0	35.05	32.50	39.00	35.12	35.62
Mean	82.5	84	96.5	89.5		31.66	30.81	35.62	30.47	
C.D. 5% for management	N.S.					N.S.				
					12 months					
D_0	27	14	68	45	38.5	48.63	33.20	50.84	58.46	47.80
D_1	15	28	28	21	23.0	60.52	52.25	47.28	50.56	52.65
Mean	21	21	48	33		54.60	42.72	49.09	54.51	
C.D. 5% for management	N.S.					N.S.				
					24 months					
D_0	10	D	52	20	20.5	14.25	D	52.09	21.31	21.91
D_1	D	D	18	16	8.5	D	D	25.33	26.89	13.06
Mean	5	D	35	18		7.13	D	38.71	24.10	
C.D 5% for management	18.07					22.67				
					36 months					
D_0	D	D	38	17	13.75	D	D	47.90	19.40	16.82
D_1	D	D	14	11	6.25	D	D	25.40	26.10	12.88
Mean	D	D	26	14		D	D	36.65	22.75	
C.D. 5% for management	15.80					26.07				

D = Dead

Table 6

Effect of soil management treatments on survival and height of A. lebbek in sodic soil

Treatment	Survival (%)					Height (cm)				
	M_0	M_1	M_2	M_3	Mean	M_0	M_1	M_2	M_3	Mean
					6 months					
D_0	73	50	81	83	71.8	31.83	32.45	36.66	35.36	34.07
D_1	37	36	83	76	58.0	35.27	26.40	37.30	37.83	34.19
Mean	55	43	82	79.5		33.55	29.43	36.98	36.63	
C.D. 5% for management	15.71							N.S.		
					12 months					
D_0	D	D	2	1	0.75	D	D	12.12	14.25	6.59
D_1	3	D	4	1	2.0	12.50	D	10.94	8.75	8.05
Mean	1.5	D	3	1		6.25	D	11.53	11.50	
C.D. 5% for management	N.S.							N.S.		

D = Dead

690% more in M_3 treatment after 2 and 3 years respectively (Table 7).

Acacia nilotica: Survival of plants in M_2 and M_3 treated plots were more than 90 per cent after six months which decreased slightly (90 and 82%) within 3 years (Table 4). However, under M_0 and M_1 treatments survival of *A. nilotica* was only 18 and 15% respectively after 6 months and all plants died within 2 years.

Response of treatments on height growth was not significantly different after six months, however, it became conspicuous within one year and the average difference of M_2 and M_3 was 4.6 times more than M_0 and M_1 treatments. Data in Table 4 shows that the plants under M_2 and M_3 treatments kept gaining height throughout the period of study and were 88.6 and 87.6 cm respectively after 3 years. Collar circumference of plants in M_2 and M_3 treatments were 4.28

Table 7

Effect of soil management treatments on collar circumference in sodic soils

Treatment	Collar Circumference (cm)									
	24 months					36 months				
	M_0	M_1	M_2	M_3	Mean	M_0	M_1	M_2	M_3	Mean
					Tamarix articulata					
D_0	D	D	5.7	8.0	3.42	D	D	6.3	9.0	3.82
D_1	D	D	5.1	6.2	2.82	D	D	5.8	7.2	3.25
Mean	D	D	5.4	7.1		D	D	6.1	8.1	
C.D. 5% for management			1.81					1.68		
					Prosopis chilensis					
D_0	0.6	1.9	10.0	8.0	5.12	0.7	1.0	10.3	8.3	5.07
D_1	0.6	1.9	7.0	7.2	4.18	1.8	2.1	7.1	7.6	4.65
Mean	0.6	1.9	8.5	7.6		1.3	1.6	8.7	7.9	
C.D. 5% for management			2.64					2.98		
					Acacia nilotica					
D_0	D	D	5.2	5.4	2.65	D	D	6.6	6.9	3.37
D_1	D	D	4.3	5.5	2.45	D	D	5.3	5.9	2.80
Mean	D	D	4.7	5.5		D	D	5.9	6.4	
C.D. 5% for management			1.54					1.64		
					Pongamia pinnata					
D_0	0.8	D	3.8	1.9	1.62	D	D	4.0	1.9	1.48
D_1	D	D	1.9	2.3	1.05	D	D	2.0	2.6	1.15
Mean	0.4	D	2.9	2.1		D	D	3.0	2.3	
C.D. 5% for management			2.63					2.36		

D = Dead

cm and 6.0 cm after 2 years and 5.5. and 6.4 cm after 3 years respectively (Table 7).

Pongamia pinnata : During early months of planting, survival of plants remained more than 80% and were statistically at par between different soil management treatments (Table 5). Effect of treatments became apparent after two and three years and were 35 and 26% in M_2 and 18 and 14% in M_3 respectively as compared to 5% in M_0 and none in M_1 treatments.

Similarly, significant increase in height growth in second year was noticed. Height of plants was 7 cm in M_0, 39 cm in M_2 and 24 cm in M_3 treatments after 2 years and 32 and 23 cm, respectively after 3 years. Collar circumference were 2.87 and 3.00 cm after 2 years and 2.06 and 2.25 cm after 3 years in M_2 and M_3 treatments, respectively (Table 7).

Albizia lebbek : Effect of treatments on survival was noticed upto six months and gradually all the plants died after one year (Table 6). Unlike survival, the height of plants did not express the influence of treatments from the very beginning. The study on this species was abandoned after one year.

Discussion

Aforesaid observations lead to infer that M_2 and M_3 soil management treatments are capable of creating congenial soil environment for tree survival and growth under highly sodic soil conditions. These soil management practices, as such, seem to be suitable for raising successful plantation of selected species on highly degraded sodic wastelands.

Amongst the five species studied, *Prosopis chilensis, Tamarix articulata* and *Acacia nilotica* were more promising than *Pongamia pinnata. P. chilensis* was the only species which survived under no soil management treatment (M_0) whereas *T. articulata, A. nilotica* and *P. pinnata* struggled for survival and ultimately died after one year. It may be noted that *Albizia lebbek* failed to survive under any soil management treatment after one year. More studies are required to findout the reasons for the mortality of A. lebbek.

Yadav and Singh (1970) found pH 9.5 as the safe limit for *P. juliflora* and less than pH 9.0 for *A. nilotica*. Khan and Yadav (1962) reported that *A. nilotica, P. juliflora* and *T. articulata* can grow in alkali soils. According to Chaturvedi *et al.* (1987), when no amendments and fertilizers were applied, *A. lebbek* died between third and fourth year whereas *P. juliflora* showed best growth at Banthara farm, Lucknow.

It may be also be noted that the application of rice-husk as mulch alone without any soil amendment as in M_1 treatment is not beneficial to plants and in same cases survival and growth has been lower than the control, though not statistically significant. This may be due to unfavourable soil structure resulting in poor soil aeration. Addition of mulch in this condition may have increased CO_2 concentration in soil air causing suffocation of plant roots resulting in growth retardation or death of plants. The same is also true for M_3 treatment where additional mulch was applied without gypsum in the second year resulting in retarded growth of plants in M_3 treatment as compared to M_2 treatment.

It was further noted that the Drainage treatment (D_1) had no statistically significant effect on survival and growth of species

studied and generally were lower than no drainage treatment. This treatment was incorporated to see whether drainage can reduce the salt concentration of the epipedon. Initial observation showed no definite trend but it is postulated that after 5 years of experimentation, sodium concentration of the epipedon will decrease appreciably so that soil is more hospitable for plant growth. For this purpose soils study are being carried out separately.

The study conclusively confirmed that soil management treatments which include application of amendment (gypsum 3 kg), ameliorant (rice-husk, 2%), mulch (rice husk, 1%), fertilizers (urea 50 g in three splits, single super phosphate 50g, muriate of potash 25g and zinc sulphate 0.2g) and insecticide (BHC 5g) increased survival per cent and height growth of all the species tried. Yadav *et al.* (1972) reported beneficial effect of gypsum, farmyard manure and fertilizers under sodic soil conditions. Similar observations were also reported by Abrol and Gill (1988).

Conclusion

The study to develop soil technology for afforestation of sodic soils of Haryana revealed that the dug up soil mixed with 3% gypsum, 20g urea, 50g single super phosphate, 25g muriate of potash, 5g BHC, 0.2 g zinc sulphate and 2 kg rice-husk when refilled and planted with seedlings gave the best result. Among the five species tried, *P. chilensis* was the best followed by *T. articulata* and *A. nilotica*. *P. pinnata* survived but had very slow growth in the first three years. A. lebbek is not a suitable species for highly sodic soil.

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SUMMARY

In order to develop technology for afforesting highly sodic wasteland soils, field experiment consisting of four soil management treatments with and without drainage channel on five species was laid out on sodic (pH 9.7, conductivity 1.3 ds/m) Revar soils of Kurukshetra Forest Division in Haryana. The study brought out that best results could be obtained with treatment M_2 which consists of mixing original soil with 3 kg gypsum, 2 kg rice-husk, 50g urea (in three split doses), 50g single super phosphate, 25g muriate of potash, 0.2g zinc sulphate and 5g BHC. Amongst the species tried, *P. chilensis* was most promising followed by *T. articulata* and *A. nilotica*. *P. pinnata* survived but growth rate was very slow. *A. lebbek* was not found to be the suitable species for highly sodic soils. The observations are continuing.

सोडा मृदाओं के वनीकरण की प्रौद्योगिकी का विकास - शिम्बिवर्गीय जातियां

एस0डी0 शर्मा, के0जी0 प्रसाद, लाजपतराय व नरेश मलिक

सारांश

अत्यधिक सोडे वाली बंजर भूमियों के वनीकरण की प्रौद्योगिकी विकसित करने के लिए हरियाणा के कुरुक्षेत्र वन मंडल की सोडीय (पीएच0 9.7, संचालकता 1.3 ds/मी0) रेवार में जल निकास धारा रखे बिना और उसे रखकर चार मृदा उपचारों में पांच वृक्ष जातियां लगाकर क्षेत्र संपरीक्षण किए गए। अध्ययन से ज्ञात यह हुआ कि सबसे अच्छे परिणाम एम$_2$ उपचार से मिलते हैं जिसमें मूल मिट्टी में 3 किग्रा जिप्सम, 2 किग्रा चावल की भूसी, 50 ग्राम यूरिया (3 मात्राओं में बांटकर), 50 ग्राम सिंगल सुपर फास्फेट, 25 ग्राम म्यूरिएट आफ पोटाश, 0.2 ग्राम जिंक सल्फेट और 5 ग्राम बीएचसी मिलाए जाते हैं। परीक्षित जातियों में सबसे उत्साहप्रद *पा0 चायलेसिस* रही जिसके बाद क्रमशः *ट0 आर्टिकुलेटा* और *अ0 नीलोटिका* रही। पा0 *पिन्नेटा* लगी तो रही परन्तु इसकी बढ़वार बहुत धीमी थी। अत्यधिक सोडीय मृदाओं में लगाने के लिए *ए0 लेब्बेक* उपयुक्त नहीं रही। पर्यवेक्षण अभी चल रहे हैं।

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INFLUENCE OF MATURITY AND PHYSIOLOGICAL STATUS OF WOODY CUTTINGS : LIMITS AND PROMISES TO ENSURE SUCCESSFUL CLONING

SUNIL PURI * AND AMARJEET KHARA**

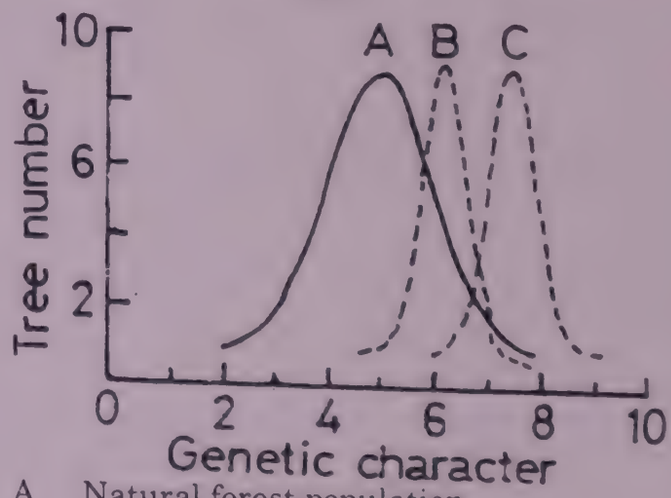
Introduction

Vegetative propagation in a tree improvement context is important for basic genetic research and for promoting clonal silvicultural development (Zobel and Talbert, 1984; Kremer, 1986). Vegetative propagation provides an opportunity to harness and exploit genetic variation directly. It also help to make investment in forestry more attractive by (a) increasing yield and quality; (b) shortening rotation and (c) allowing some of the biological problems hindering reforestation with hardwood species. The superiority of vegetative propagation by comparison with sexual regeneration lies in the possibility of transferring the whole genetic potential of a selected tree, the donor tree or ortet, to its asexually reproduced progeny. This is a major argument in favour of vegetative propagation and it is commonly advocated as an alternative to breeding (Zobel, 1981). Moreover, tree populations are highly heterozygous (Bongs, 1987; Singh and Puri, 1987) and vegetative propagation helps to utilize maximum genetic gains in a shortest time.

The genetic variation in a tree population comprises of additive and non-additive variation. The genetic gain due to additive type of variation can only be achieved by sexual reproduction. The non-additive type of genetic variation, which results from specific combination of genes within an individual or family, can only be exploited through vegetative propagation, i.e. cloning. The use of cloning technique achieves large genetic gains through intensive selection and by using certain non-additive gene effects. This also help in obtaining greater uniformity. These aspects are illustrated in Fig. 1.

The curve A in the figure represents a

Fig 1



A Natural forest population
B Breeding population
C Improved F1 progeny

Genetic variation in a Forest population. Curve A depicts variabilitity range in a forest population; Curve B represents population improvement by selection; Curve C reperesent population improvement by selective breeding and selection.

* Department of Forestry, Haryana Agricultural University, Hisar.
** HARSAC, Haryana Agricultural University, Hisar

range of values for a particular trait in a forest population. These values represent both genetic and environmental influences [Phenotype (P) = Genotype (G) + Environment (E) + GE]. By selecting only those individuals of high genetic worth, breeding programmes achieve genetic gain for the desired traits above the mean value of the forest population as represented by curve B in Fig 1. Through selective breeding and selection of superior offsprings further improvement is achieved over time, as represented by curve C. This group of elite trees could be cloned directly to mass produce planting stock.

Techniques

Methods for vegetative propagation of forest trees include the more traditional methods of rooting cuttings, grafting, and air-layering (macropropagation) as well as the most recently developed methods of tissue culture (microporpagation) such as induction of adventitious buds on cultured embryo and seedling tissues, shoot tips, and unorganised callus and cell cultures. These have been summarized in Fig 2. The detailed techniques can be seen in any standard text books (e.g., Hartmann and Kester, 1983). However, of various methods of vegetative propagation of forest trees species, the most successful on a large scale is the rooting of shoot cuttings. Stem or shoot portions are generally very good material for rooting purposes, because they usually have undifferentiated tissues which army permit initiation of root primordia, and they also have buds already formed. The frequent early flowering of shoot cuttings can save time and makes the work of the tree breader casier as he can work much closer to the ground.

Rapid strides have been made in the micropropagation techniques during the last one decade (Bajaj, 1986; Bonga and Durzan, 1987; Puri and Monga, 1989). However, it is an expensive technique compared with other propagation methods for multiplication. Either the labour cost of micropropagation would need to be significantly reduced or alternative techniques (e.g., somatic embryogenesis) become available for micropropagation to become competitive. In forestry, the commercial applications of it are still in its infancy, but a few tree species have been regenerated through tissue culture during the past 6-10 years (Bajaj, 1986). However, the present paper is not aimed to discuss this technique in detail.

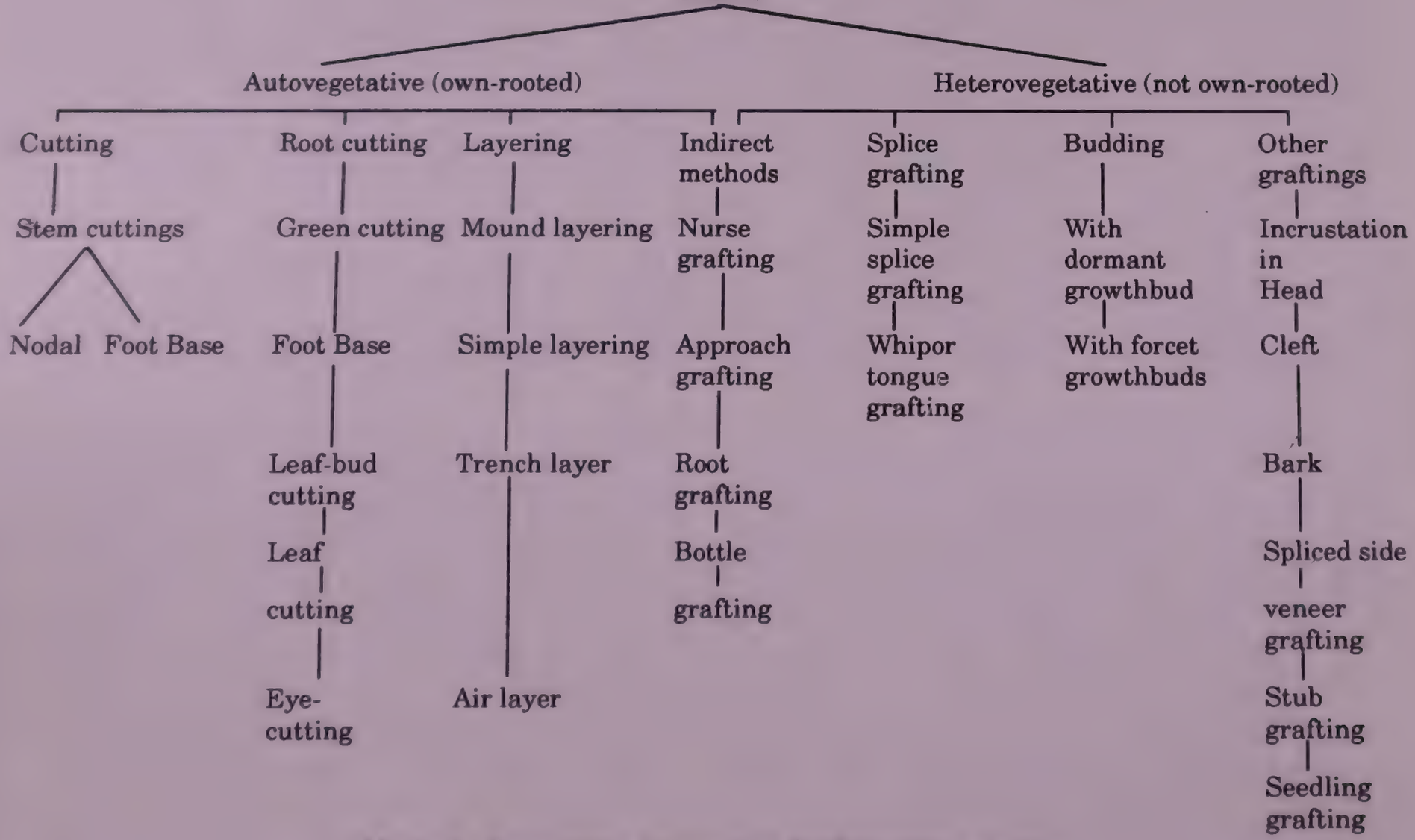
Ortet characterstics affecting cloning ability

Cloning capacities of a selected tree could be influenced by endogenous factors likely to interact, and which are fundamentally: genetic identity, degree of maturation and physiological state.

Genetic Identity : This refers to the taxonomic origin of the individual as well as to its specific genotype. It is well known that some species and especially those that sprout from the base of the trunk or produce suckers, such as, *Populus* spp., are easier to clone than others. Moreover, differences in cloning abilities may exist within species between different genotypes (Khurana *et al.*, 1984; Morgenstern *et al.*, 1984).

Maturation : The age of maturational state of the donor plant plays a major role in the efficiency of propagation and the performance of propagules. With rooted cuttings, maturational changes result in reduced rooting ability, reduced root quality, increased time to rooting, reduced shoot growth and vigour.

Fig. 2



Methods of vegetative propogation for Forest tree species

Cuttings of *Casuarina equisetifolia* at different maturity levels were tested for rooting capacity and the results are presented in Table 1. Three types of cuttings were taken, viz., mature hardwood (brown stem and woody), mature softwood (green stem) and juvenile cuttings (new shoots from the stump). It was observed that older stem cuttings were difficult to root and also took longer time. However, these could be rooted with auxin (see hormonal control section). Softwood stem cuttings were most easily rooted.

Maturation of the cutting increased plagiotropism (continued growth of a branch cutting as a branch). Moreover, the time required for a shoot to grow out of the plagiotropic habit also increased with maturity. Degree of plagiotropism varies among species, and is quite prominent in gymnosperms (Klaehn, 1963).

These maturational state effects create a problem for vegetative propagation because the precision with which superior trees can be selected increases with the age of the trees (Lambeth, 1980). Three approaches are generally used to delay or reverse maturation, viz., hedging, serial repropagation, and *in-vitro* culture (Thompson, 1984).

Physiological state: Although difficult to define concisely, physiological state must be considered as the result of different physiological components - including tropic and hormonal systems, which are themselves

Table 1

Rooting and callus formation of mature hardwood, mature softwood and juvenile stem cuttings in Casuarina

Treatment *		Mature hardwood		Mature softwood		Juvenile	
		Callused (%)	Rooted (%)	Callused (%)	Rooted (%)	Callused (%)	Rooted (%)
Water control		40	24	92	8	8	12
IAA	25	60	12	40	0	0	8
	50	60	20	76	8	0	12
	100	10	60	40	20	8	20
IBA	25	20	0	52	20	8	20
	50	40	20	20	84	0	24
	100	10	90	40	48	12	32
NAA	25	40	12	36	28	0	20
	50	20	48	32	80	0	20
	100	10	0	12	0	20	32

* Auxins were given as 3 h soaking before planting in a bed, 25 cuttings/treatment. Data collected after 35 days.

influenced by various exogenous climatic and edaphic factors to determine a particular physiological status suited for true-to-type vegetative reproduction. It will not be possible to discuss all these factors in detail. However, the important ones will be discussed with experiences from our studies.

(a) *Water-Relations* : The availability of water is one of the most important factors for triggering root development, as the cuttings have to maintain a favourable water balance whilst roots develop. Cuttings initially absorb water through the cut stem and/or bark. Several studies have shown that soaking hardwood cuttings prior to planting increases subsequent survival and growth (Krinard and Randall, 1979; Hansen and Phipps, 1984; Puri and Thompson, 1990).

Studies were conducted to examine the rooting behaviour in *Populus euramericana* as influenced by the initial water potential (-0.06 and -0.6 bars). Variation in the initial water potential of the cutting was achieved by three pre-treatments, i.e., fresh, soaked and dried. Fresh cuttings were planted directly; soaked cuttings were immersed to a depth of 15 cm in water for 15 days; and dried cuttings were obtained by keeping cuttings in the open in the cold room for 7 days before planting in two soil moisture treatments.

The number of roots and their length over time are presented in Table 2. The development of roots in terms of both number and total length was poor and allow for cuttings planted in stressed soil (-0.6 bar). The root number was maximum in the soaked cuttings. The increase in total length of root was significantly altered by pretreatment of the cuttings in the two soil moisture potentials (Table 2). Presoaking stimulated rooting of hardwood cuttings of *Populus*. Soaking enabled cuttings to absorb sufficient moisture for initial root development even under the drier soil moisture conditions tested. The drying of cuttings before planting adversely affected rooting and growth. Dried cuttings planted in -0.6 bar soil showed minimum rooting and took more time period to root.

The pre-treatments of soaking and drying of stem cuttings had significantly increased and decreased the initial moisture content. In fresh stem cuttings the initial moisture content was 95.4 per cent while in soaked and dried cuttings it was 123.2 and 74.9 per cent, respectively. The stem moisture of both fresh and dried cuttings increased in moisture content with time. The moisture content decreased initially in soaked cuttings, pre-sumably due to high initial moisture and later on increased. The moisture content of stem cuttings planted in two soil tensions, i.e. -0.06 and -0.6 bars, varied with regard to time taken for regaining moisture as in dried soils it took more time.

On contrast the root moisture content after a brief initial rise declined to almost half its maximal value. This may be attributed to the fact that during the early development of roots only cell elongation and cell division processes have occurred (Esau, 1960) and water plays an important role during these processes (Cameron and Rook, 1974). Later on in root development, lignification and hardening of roots takes place (Esau, 1960) and this decreased the moisture content.

Changes in water potential of the shoot and bark; osmotic potential changes; and pressure potential changes were also studied in *Populus*. Initial Ψ shoot in different pre-treatments was -14.5 bar in fresh, -

Table 2

Rooting in fresh, soaked and dried cuttings of Poplar planted in two soil moisture tensions (values are Mean + SD)

Soil moisture (Bars)	Day	Root Number			Total Root Length (cm)		
		Fresh	Soaked	Dried	Fresh	Soaked	Dried
-0.06	3	0	1.0 ± 0.3	2.6 ± 1.2	0	0.3 ± 0.1	0.7 ± 0.4
	5	5.0 ± 1.6	2.3 ± 0.9	4.6 ± 2.0	4.1 ± 1.3	3.5 ± 1.0	11.9 ± 2.0
	7	9.6 ± 1.2	3.3 ± 0.4	4.6 ± 2.4	27.2 ± 2.9	23.2 ± 3.4	48.9 ±32.5
	10	6.0 ± 0.8	4.6 ± 0.4	6.0 ± 0.8	51.1 ± 6.0	54.2 ± 10.0	72.1 ±31.9
	13	9.3 ± 1.2	5.0 ± 1.4	10.3 ± 4.7	88.1 ± 6.6	52.6 ± 6.6	134.0 ±51.9
	16	10.1 ± 2.0	14.6 ± 5.1	10.3 ± 2.4	87.7 ± 18.0	141.0 ± 30.4	121.7 ±20.0
	20	11.6 ± 2.4	15.0 ± 5.0	10.3 ± 1.2	153.1 ± 43.6	168.4 ± 37.8	195.6 ±22.6
	25	12.0 ± 4.3	15.0 ± 3.5	14.0 ± 2.4	254.3 ± 45.9	168.6 ± 64.5	222.9 ±19.6
-0.6	5	0	5.0 ± 1.6	0	0	9.4 ± 6.8	0
	7	3.3 ± 1.2	5.0 ± 3.5	0	3.6 ± 0.8	37.4 ± 26.9	0
	10	5.6 ± 0.8	4.0 ± 2.4	2.3 ± 1.2	15.8 ± 3.0	33.8 ± 12.4	7.7 ± 3.6
	13	6.0 ± 1.4	6.6 ± 1.2	2.0 ± 0.8	27.6 ± 6.3	44.1 ± 10.1	13.1 ± 2.3
	16	5.6 ± 2.0	6.7 ± 0.4	2.3 ± 1.2	25.2 ± 17.8	39.8 ± 9.8	32.7 ± 2.1
	20	7.6 ± 1.2	7.0 ± 2.9	7.0 ± 2.1	40.0 ± 1.6	55.8 ± 21.9	49.5 ±13.7
	25	8.3 ± 0.4	10.0 ± 2.1	8.6 ± 2.4	51.8 ± 3.6	83.6 ± 14.8	81.6 ±12.6

-1.0 bar in soaked, and -21.0 bar in dried cuttings. The shoot was more in wet soil as compared to dried soil. In fresh and dried cuttings, the Shoot increased initially; only in the case of fresh cuttings it decreased subsequently. The Ψ shoot of soaked cuttings behaved differently initially, as the high initial Ψ shoot had decreased. However, later on all the cuttings attained almost equal Ψ shoot.

The bark water potential (Ψ bark) of the cuttings was initially -11, -1 and 12-5 bars for fresh, soaked and dried cuttings, respectively. All the pre-treated cuttings planted in -0.6 bar soil and soaked cuttings of -0.06 bar planted cuttings, showed initial decrease in potential and later on it increased. The bark potential of fresh and dried cuttings planted in wet soil increased and then remained almost constant. The bark was virtually the same for both soil moisture levels by the 25th day.

In fresh cuttings planted in -0.06 bar soil, Ψ solute increased initially and then it decreased. However, cuttings planted in -0.6 bar soil decreased in solute initially and then increased. The soaked cuttings also showed a decrease in Ψ solute initially. The Ψ solute of dried cuttings increased in both the soil treatments initially. However, in the drier soil it decreased later on. The turgor pressure (Ψ p) more or less followed the pattern of solute but exaggerated any rises of potential, due to fall in Ψ bark often being associated with rises in osmotic potential of the expressed sap.

It is concluded from the afore mentioned results that the initial moisture content and potentials of the cutting and of the soil play an important role. Once well developed roots were formed the water potential (both of shoot and bark) stabilises irrespective of pre-treatment. Depending upon pre-treatment and soil moisture, the roots were observed between 3rd to 5th day. Changes in water potential as well as osmotic potential show that these early roots did not seem to have ability to absorb water as the potential increased even after their formation. However, as they elongated and grew, they attained the ability to absorb water.

(b) Carbohydrates : Root initiation requires energy. Degradation of carbohydrates via the Embden-Meyerhof-Parnas glycolytic pathway or ribose-5-phosphate or pentose phosphate pathways constitutes the likely source of energy in cuttings, simply because other energy sources, such as lipids, prevail less generally and abundantly in stems. Many investigators have, in fact, positively related carbohydrate levels in cuttings with the ability to initiate root primorida (Nanda and Anand, 1970; Haissig, 1974, 1982). Starch, where present, acts as the prime and possibly sole carbohydrate source for root primorida initiation and development (Haissig, 1974).

Starch content was studied in Poplar cuttings planted in dry (-0.6 bar) and wet (-0.06 bar) soil. The cuttings taken were fresh, soaked and dried (see section on water relation). The starch content decreased with time in all the treatments. The continued loss of starch from hardwood segments is attributable to an export of carbohydrate to the developing roots. The depletion of starch was faster in water soil and the rate of depletion was maximum in soaked cuttings. Probably the soaked cuttings are metabolically more active. Haissig (1982) was uncertain whether carbohydrate supported primordia development in callus tissue only as an energy source in respiration, as opposed to osmotic effects on metabolism, during adventitious development of root

primordia.

(c) *Hormonal Controls* : There are conflicting statements concerning the effects of hormone applications on root formation; some report a definite stimulus, others no effect at all (Cameron, 1968). Our own experience shows that it varies from species to species (Table 3). In *Robinia pseudocacia* IAA was responsible for maximum rooting, while in *Caltis australis* IBA proved to be much effective. The effect of growth regulators also varies with the maturity of cutting. Different aged cuttings of *Casuarina equisetifolia* when treated with auxins responded differently (Table 1). Both mature softwood and hardwood cuttings could be rooted with auxin treatment, which otherwise were difficult to root. Callus formation usually accompanied any successful rooting response. IBA (100 mg/l) was more successful in rooting mature stem cuttings (Table 1). Softwood stem cuttings rooted easily and the application of auxin (particularly IBA or NAA at 50 mg/l) enhanced rooting response. Callusing was abundant even without auxin treatment and tended to be repressed by concentrations favourable to root initiation

Table 3

Effect of growth regulators on percentage rooting and average root length (Source Puri and Shamet, 1988).

Growth Regulator (ug/l)		*Robinia pseudocacia*		*Celtis australis*		*Grewia optiva*	
		% R	L	% R	L	% R	L
Control		30	3.3	20	3.6	0	-
IAA	10	80	6.9	80	2.8	10	2.1
	100	70	5.9	90	2.7	40	4.3
	250	70	8.7	60	3.8	20	6.0
	500	70	7.0	50	1.6	10	2.7
	1000	30	4.4	20	1.9	0	-
IBA	10	50	4.3	90	4.6	0	-
	100	50	3.1	90	3.7	30	1.8
	250	30	4.5	40	2.6	0	-
	500	60	3.2	10	2.9	0	-
	1000	40	4.5	8	3.1	0	-
NAA	10	40	3.3	10	3.3	20	4.8
	100	60	4.7	60	2.9	20	4.5
	250	50	5.5	90	3.5	30	5.7
	500	50	4.7	50	3.5	0	-
	1000	10	2.9	0	-	0	-

% R = Percentage rooting L = Average root length (cm)

(Table 1).

Root formation in cuttings is a complex phenomenon in which there are at least three distinct steps: callus formation; differentiation within callus resulting in root initiation, and root growth. Cameron (1968) postulated that each step is controlled in different ways by balances of hormones, inhibitors and other biochemicals. Thus the simple application of any one synthetic auxin, applied against a background of natural growth regulators that vary with age of plant and time of year, will give consistent results. However, in most of the cases, the application of auxins substantially increases movement of photosynthetes to the site of root initiation (Cameron, 1968; Nanda *et al.*, 1969; Nanda and Jain, 1971; Haissig, 1974; Puri and Shamet, 1988).

Conclusion

Rapid advances are being made in methods of vegetative propagation. Many biological limitations have been overcome by the use of juvenile material and proper environment. Moreover, the potential for increased genetic gains through the use of vegetative propagation has been demonstrated for many forest tree species. Historically, most emphasis in vegetative propagation has been placed on rooted cuttings. Research emphasis has shifted to tissue culture because by this more mature superior trees can be propagated. However, due to economic constrains the tissue culture is still not followed at a commercial scale.

Clonal reforestation is now a reality through the use of rooted cuttings of juvenile material. In West Germany, rooted cuttings of Norway spruce account for 30 to 40 per cent of the total planting stock (Kleinschimit and Schmidt, 1977). Similarly, in Japan about 20 per cent of the Japanese cedar currently planted is propagated by cuttings. Besides West Germany and Japan, Norway, Finland, Sweden, Scotland, Brazil, Canada, New Zealand and Australia have successfully undertaken clonal reforestation. The question is no longer *is* clonal forestry a success, but rather *when* will it become prevalent in India.

The risks, generally associated with clonal forestry, arise from restricting the genetic diversity of plantations when reducing the number of clones from many to one or a very few. A safe number of clones depends on the rotation age, genetic variability of the species, genetic diversity of the clones and acceptable risks (Zobel, 1981). It is commonly assumed that the larger the number of clones the lower the risk of loss. Libby (1982) opined that 7 to 30 clones would be safe for use in a clonal plantation.

SUMMARY

Vegetative propagation methods make possible the production of exact copies of trees selected for superior characteristics. These methods include conventional techniques such as rooting cuttings, grafting, and air-layering, as well as newer plant tissue culture methods that include embryo or cotyledon culture, shoot tip culture, and callus and cell culture. The most commonly practiced technique is rooting stem cuttings and this is being discussed in detail. Rooting ability of the cutting is influenced by genetic component, physiological state of the cutting and the environment in which the cutting is planted. Hormonal changes occurred with season, but these are complex and are not yet well understood. Depletion of metabolic food reserves, particularly starch, takes place rapidly during rooting. Alleviation of moisture stress is critical to rooting of cuttings and high humidities are required. Cuttings take up water through the cut base of the shoot and pre-soaking of cuttings stimulated rooting even in the drier soil moisture conditions. Initially the water potential of cuttings decreased with time and with the formation of roots it stabilized. In the application of the results presented, it is envisaged that both physiological and environmental factors influence rooting to stem cuttings. The biological limitations, particularly in relation to number of clones for afforestation purposes, is being discussed.

काष्ठीय कलमों की पौढ़ता और देह व्यापारिकीय स्थिति का प्रभाव:
कृन्तक बनाने की सफलता सुनिश्चित करने के लिए इसकी सीमाएं और संभावनाएं

सुनी पुरी व अमरजीत खरा

सारांश

वर्धी प्रवर्धन विधियों से श्रेष्ठतर गुणों के कारण चुने गए वृक्षों की हूबहू प्रतियां तैयार करना संभव हो जाता है। इन विधियों के अन्तर्गत कुछ पारम्परिक प्रविधियां आती है जैसे कलमों में जड़ें निकलवाना, पेबंद लगाना और गूटी बांधना और कुछ नव्यतर पादप ऊति संवर्धन विधियां भी, जिनमें भ्रूण या बीजपत्र संवर्धन, प्ररोह की नोक का संवर्धन तथा किण और कोशा संवर्धन हैं। व्यवहार की जाने वाली सबसे आम रीति तने से काटी गई कलमों में जड़े निकलवाने की है और इसी का विस्तृत विवेचन यहां किया गया है। कलम की जड़ें उत्पन्न करने की योग्यता पर इसके प्रजनन अंग, कलम की देह-व्यापारिक स्थिति और उस पर्यावरण का, जहां उसे लगाया जाए, प्रभाव पड़ता है। मौसम के साथ हार्मोन परिवर्तन होते हैं परन्तु ये बहुत जटिल हैं और अभी तक इन्हें भली-भांति नहीं समझा जा सका है। चयापचय होने वाले संरक्षित भोज्य पदार्थ, विशेषकर मंड (स्टार्च), जड़ें निकलते समय तेजी से घटता है। कलमों की जड़े निकलने में नमी का दबाव अधिक होने का प्रभाव परिवर्तनकारी होता है और इसके लिए अधिक नमी की आवश्यकता होती है। कलमें अपने लिए जल प्ररोह के कटे हुए आधार से लेती है और कलमों को पहले भिगो कर रखना अधिक शुष्क नमी आद्रर्ता तक में उनकी जड़े निकलने में उत्तेजना देता है। प्रारम्भ में कलमों की जल लेने की शक्ति समय के साथ घटती है परन्तु जड़ें बन जाने पर यह सुस्थिर हो जाती है। यहां प्रस्तुत किए परिणामों को उपयोग में लाने के लिए हमारा विचार है कि तने से काटी गई कलमों में जड़े निकलने पर दैहिक और पर्यावरणिक दोनों कारक प्रभाव डालते हैं। जैविकीय सीमाएं, विशेषकर वनीकरण प्रयोजनों के लिए कृन्तक बनाने की संख्या से संबंधित, भी विवेचित की गई हैं।

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WORKING QUALITIES OF INDIAN TIMBERS - PART IX

B.C. PANT, K.S. SHUKLA AND S.P. BADONI,

Wood Working & Finishing
Forest Research Institute, Dehra Dun (India)

Introduction

Systematic evaluation of working qualities of Indian timbers forms a major activity in the research programme on wood working and finishing. Keeping this in view, the Indian Standard IS: 8292-1976 on procedures for evaluation of the working qualities of wood was formulated and adopted. Following this Standard about 70 species from various parts of the country were evaluated earlier for their working qualities under six major wood working operations. Data on these has been published from time to time (Rawat *et al.*, 1972, 1974, 1976, 1980; Shukla *et al.*, 1983; Rajput *et al.*, 1983 and Pant *et al.*, 1989).

Necessity of data on working qualities of more and more native timbers is being felt as species differ widely in their machining qualities as influenced by density, fibre structure, presence of inter-locked grains, mineral streaks, tension wood etc. Proper knowledge of working qualities of lesser known species is becoming important day by day as traditional timbers are becoming scarce and beyond the reach of common man. Therefore, to augment the data further five new species namely - *Araucaria cunninghamii, Azadirachta indica, Jakaranda acutifolia, Jaonessia principes* and *Populus ciliata* were brought into purview of present study. The overall performance under six major wood working operations, ease of working and working quality index for each of the species have been worked out and compared with teak taken as 100 and presented in this paper.

Material

The logs of *Populus ciliata* and *Azadirachta indica* were received from Himachal Pradesh and Haryana States respectively and logs of remaining 3 species were collected from New Forest, Dehra Dun. These logs were converted into planks of 2.90 cm thickness and seasoned to 12% m.c. From the seasoned planks, smaller planks of size 120 cm x 10 cm x 2.5 cm were obtained. Care was taken to see that these planks were as far as possible straight grained and free from defects like knots, stains, apparent decay, surface checks, end splits etc. Sapwood was also avoided to the extent possible. Each plank was further converted into test specimen for testing them under different operations as detailed in the above Indian Standard.

Experimental Procedure

Equipment used in carrying out the above mentioned six wood working operations and the experimental procedure

followed in this study was similar to that reported in earlier publications (Rawat *et al.*, 1972) and also in Indian Standard (IS: 8292-1976).

Observations and presentation of data

Defects : Worked surface of each specimen in various wood working operations was visually examined for defects as detailed below:

Operation	Defects examined
Planing :	Raised grain, fuzzy grain, torn grain and chip marks.
Sanding :	Scratching, fuzzyness or woolliness and snaking.
Turning :	Roughness, fuzzy grain and torn grain
Shaping :	Raised grain, fuzzy grain, chipped grain and rough-end grain.
Boring :	Roughness, fuzzy grain, tear out and crushing.
Mortising :	Roughness, tear out and crushing.

On the basis of severity of above defects occurring on worked surface, defect values of 0, 1, 2, 3, 4 and 5 were allotted to each defect. The defect value '0' represents in planing for raised grain, percentage of specimens free from raised grain whereas defect value '5' represents percentage of specimens full of severe raised grain. Further, the same specimen was observed for other defects and appropriate defect value 0, 1, 2, 3, 4 or 5 was allotted. Analysis of defects in planing, sanding, turning, shaping, boring and mortising is given in Table 1.

Grading : Analysis of defects as discussed above highlights the individual defects that occurred on worked wood surface. It does not give overall appearance of the specimens in respect of various defects. Therefore, grading of the specimens was carried out taking into account the severity and extent of defect/defects that occurred on worked wood surface in different wood working operations. Severity of defect/defects was assessed and defect values of 0, 1, 2, 3, 4 and 5 were allotted to each defect. Here defect value '0' indicates specimen free from all defects. These were then summed up for cumulative effect. On the basis of total defect/defects value grading of the specimens was done as follows:

Grade	I	Excellent Defect free specimens. Total defect value-0.
Grade	II	Good-Total defect value1
Grade	III	Fair-Total defect value 2
Grade	IV	Poor-Total defect value 3 to 4
Grade	V	Very poor-Total defect value 5 or more.

Observations on grading are recorded in Table 2 for planing, sanding, turning, shaping, boring and mortising. Further from Table 2 optimum cutter angles in planing were determined on the basis of cutter angle which gave maximum number of defect free specimens (Gr. I), and these are reported in Table 3 for species under investigation.

Rating Factor : From the Table 2 for grading data, rating factors for each species were calculated for comparative performance as follows:

Rating factors for different operations

Operations	Rating factor
Planing	- Percentage of Grade I (de-fect free) specimens.
Sanding	- Percentage of Grade I (de-fect free) specimens.
Turning	- Percentage of Grade I, II and III (fair to excellent) specimens.
Shaping	- Percentage of Grade I and II (good to excellent) specimens.
Boring	- Percentage of Grade I and II (good to excellent) specimens.
Mortising	- Percentage of Grade I, II and III (fair to excellent) specimens.

Rating factors indicate the extent to which a wood worker can tolerate defects in finishing operations. Rating factors worked out as above are reported in Table 3 and also as percentage of teak in Table 4 for comparison under individual operations.

Composite Rating Factor : From the above rating factors, weighted average for each species was also calculated by multiplying the rating factors with suitable adjusting factors (Planing - 1.000, Sanding - 0.351, Turning - 0.238, Shaping - 0.606, Boring - 0.274 and Mortising - 0.200) and weights (operation-weightage: Planing-4, Sanding-5, Shaping-2, Turning-2, Boring-1 and Mortising-1) keeping in view the importance of each operation. The weighted average was expressed as the percentage of teak for having an idea of comparative overall performance (Table 4) using the following formula:

$$\text{Overall Performance} = \frac{(\text{Weighted average of species}) \times 100}{\text{Weighted average of teak}}$$

Ease Factor : Ease of working for each species was worked out from the data presented in Table 1 for planing and is also reported in Table-10. The formula used for working out ease factor was as follows:

$$\text{Ease of working} = \frac{\text{Power requirement for teak} \times 100}{\text{Power requirement for species}}$$

Working Quality Index : for selecting a timber for any desired use its overall performance and ease of working are taken into consideration whereas later is given more weightage. Hence working quality index (Table 4) for different species was also worked out as detailed below:

$$\text{Working Quality Index (WQI)} = \frac{\text{Overall performance} + 2 \times \text{Ease of working}}{3}$$

Results and Discussion

On the basis of data reported in the Table 1 (analysis of defects) and Tables 2 to 3 (grading and rating of different species), the observations made on different species during six wood working operations are as follows:

Planing : An analysis of different defects which occurred in the species under study indicates that fuzzy grain and torn grain are most common defects followed by raised grain. The chip marks were observed in *Araucaria* and *J. principes* only in mentionable amounts. The order of performance on the basis of defect free specimens (Grade-I) with best cutting angle is given below:

Table

Defects observed on different

Species	Planing						Sanding			Turning		
	Cutting angle in degrees	Power requirement in KW width for 30°/CM	Raised grain (%)	Fuzzy grain (%)	Torn grain (%)	Chip marks (%)	Scratching (%)	Fuzziness (%)	Snake marks (%)	Roughness (%)	Fuzzy grain (%)	Torn grain (%)
Tectona grandis (Teak)	15	0.27	4	62	75	-	-	44	-	82	-	58
	20		4	64	58	-						
	25		4	74	44	-						
	30		6	70	46	-						
Araucaria cunninghamii (Araucaria)	15	0.22	-	16	72	70	-	32	-	-	24	8
	20		6	18	52	40						
	25		-	58	42	14						
	30		-	68	18	-						
Azadirachta indica (Neem)	15	0.29	20	82	84	-	-	40	-	4	4	24
	20		-	82	84	-						
	25		30	54	42	-						
	30		18	74	72	-						
Jakaranda acutifolia (Jakaranda)	15	0.22	-	50	52	18	-	56	-	68	4	36
	20		22	38	20	20						
	25		26	38	8	-						
	30		56	40	6	-						
Jaonessia principes	15	0.20	1	75	15	48	-	76	-	76	58	58
	20		-	95	63	1						
	25		87	69	54	2						
	30		88	95	85	6						
Populus ciliata (Poplar)	15	0.23	-	85	68	13	-	72	-	78	-	60
	20		-	100	56	-						
	25		-	100	49	-						
	30		-	100	24	-						

1

species under different operations

Shaping				Boring				Mortizing		
Raised grain (%)	Fuzzy grain (%)	Chipped grain (%)	Roughend grain (%)	Rough-ness (%)	Fuzzy grain (%)	Tear out (%)	Crushing (%)	Rough-ness (%)	Tear out (%)	Crushing (%)
46	50	48	-	18	29	14	-	7	63	-
38	-	58	-	46	26	4	8	62	78	-
30	-	46	-	67	4	76	-	52	52	-
66	-	24	-	66	-	80	30	36	68	2
83	-	89		92	64	61	5	94	96	-
77	75	21	-	94	5	92	-	94	93	-

Table 2

Percentage of acceptable specimen under different operations

Species	Planing (% of Grade I)				Sanding (% of Grade I)	Turning (% of Grade I, II and III)			Shaping (% of Grading I & II)		Boring (% of Grade I & II)		Mortizing (% of Grade I, II, III)		
	15° I	20° I	25° I	30° I	I	I	II	III	I	II	I	II	I	II	III
Tectona grandis	14	18	20	16	56	36	26	22	10	23	43	30	34	50	16
Araucaria cunninghamii	18	36	34	36	68	76	4	12	34	36	38	10	10	6	26
Azadirachta indica	16	14	24	18	60	72	20	4	40	8	38	14	20	20	42
Jakaranda acutifolia	32	24	40	28	44	52	28	8	14	22	10	8	-	12	54
Jaonessia principes	12	-	5	3	24	20	8	36	10	-	1	4	-	2	10
Populus ciliata	8	-	-	-	28	14	6	24	9	7	1	3	-	3	9

Table 3

Rating factor for different species under different operations.

Species	Planing		Sanding	Turning	Shaping	Boring	Mortizing
	Cutting angle (degrees)	Grade I Specimen (%)	Grade I Specimen (%)	Fair to excellent (%)	Good to excellent Specimen (%)	Good to excellent Specimen (%)	Fair to excellent Specimen (%)
Tectona grandis	25	20	56	64	33	73	100
Araucaria cunninghamii	20 & 30	36	68	92	70	48	42
Azadirachta indica	25	24	60	96	48	52	82
Jakaranda acutifolia	25	40	44	88	36	18	66
Jaonessia principes	15	12	24	64	10	5	12
Populus ciliata	15	8	28	44	16	4	12

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Table 4
Comparative working qualities

Species	Planing	Sanding	Turning	Shaping	Boring	Mortizing	Over all performance	Ease of working	Working quality index
Tectona grandis	100	100	100	100	100	100	100	100	100
Araucaria cunninghamii	180	121	110	212	66	42	132	123	126
Azadirachta indica	120	107	114	145	71	82	113	93	100
Jakaranda acutifolia	200	79	105	109	25	66	114	123	120
Jaonessia principes	60	43	76	30	7	12	24	135	98
Populus ciliata	40	50	52	100	5	12	42	117	92

Species	Cutting angle
Jakaranda acutifolia (Jakaranda)	25°
Araucaria cunninghamii (Araucaria)	20° and 30°
Azadirachta indica (Neem)	25°
Jaonessia principes	15°
Populus ciliata (Poplar)	15°

Thus it can be concluded that *Jakaranda, Araucaria* and Neem show better performance than teak and *J. principes* and *Populus ciliata* poorer in planing operation.

Sanding : Scratching and snake marks were not observed in any specimen after sanding. Only fuzziness or woolly surface was noticed. The order of performance of these species on the basis of Grade I specimens are Araucaria, Neem, Jakaranda, Poplar, and *J. principes.*

Araucaria and neem show better performance than teak and jakaranda, poplar and *J.principes* are poorer than teak.

Turning The most common defects in turning were torn grain and roughness. Fuzzy grain was observed only in negligible amounts in araucaria, poplar, neem and jakaranda. Roughness was noticed in *J. principes* and poplar and was totally absent in araucaria. On the basis of Grade I + II + III the order of performance of these species is Neem, Araucaria, Jakaranda, *Jaonessia principes,* and Poplar.

Thus it can be concluded that neem, araucaria and jakaranda are better than teak for turning purposes. Some of the specimens of poplar showed charring effect which made them blackish.

Shaping : In shaping most common defects were raised grain and chipped grain. Fuzzy grains were found only in poplar. The severity of defects were more on side than end faces. The order of performance of these species is as under, based on Grade I, + II, specimens are; Araucaria, Neem, Jakaranda, Poplar and *Jaonessia principes.*

Thus, it can be concluded that araucaria, neem and jakaranda showed better performance than teak, while poplar was poorer to teak.

Boring: Most common defect noticed was roughness followed by tear out and fuzziness. Crushing was not noticed in neem. Some of specimens of poplar however, showed charring effect. The total defects on the side and end faces are nearly equal. The order of performance on the basis of Grade I, + II is Neem, Araucaria, Jakaranda, *J. principes and* Poplar.

Mortising : The most common defects in mortising were roughness and tear out. Crushing was observed only in araucaria and *J. principes* in negligible amount. The total defects on side face were less than end faces. Charring effect was also noticed in some of specimen of poplar. The order of performance on the basis of Grade I, + II, + III specimens is: Neem Jakaranda, Araucaria, *J. principes and* Poplar.

Conclusion

The results reported in Table 4 indicate that the overall performance of araucaria, neem and jakaranda is better than teak and is very poor for *J. principes* and poplar. The working quality indices of araucaria and jakaranda are more than teak and of remaining species comparable to teak. These indices give an idea of overall performance of the species including ease of working.

SUMMARY

This paper is in continuation of earlier papers on systematic evaluation working qualities of Indian timbers in which results of working qualities of five more species namely *Araucaria cunninghamii, Azadirachta indica, Jakaranda acutifolia, Jaonessia principes* and *Populus ciliata* have been reported after testing them under six major wood working operations - Planing, Sanding, Turning, Shaping, Boring and Mortizing. The working quality index based on quality of worked surface and ease of working for each species are reported along with the results of *Tectona grandis* for comparis on. These results indicate that overall performance of Araucaria, Neem and Jakaranda is better than Teak. These are easy to very easy to work with hand and machine tools.

भारतीय प्रकाष्ठों के कार्य गुण - भाग IX

बी०सी० पंत, के०एस० शुक्ल व एस०पी० बडोनी

सारांश

यह अभिपत्र भारतीय प्रकाष्ठों के कार्य गुणों का विधिवत् मूल्यांकन किए जा रहे पूर्व अभिपत्रों की ही अगली कड़ी है जिसमें पांच और प्रकाष्ठ जातियों अर्थात् *एरोकेरिया कनिंघमाई, एजेडिरेक्टा इंडिका, जैकेरेण्डा एक्युटिफोलिया, जैओनेसिया प्रिंसियेस* और *पापुलस सिलियाटा* के कार्य गूणों संबंधी परिणाम छह बड़े काष्ठ कार्यों अर्थात रंदा करना, रेगमार लगाना, खराद करना, आकृति सुधारना, बरमा चलाना और काटकर छेद बनाना के लिए परीक्षित करके सूचित किए गए हैं। प्रत्येक प्रकाष्ठ जाति के कार्य गुणों को कार्य करने पर बने तल की गुणवत्ता और उस पर कार्य कराने की सरलता के आधार पर बनाए उनके कार्य गुण निर्देशांक तुलना करने के लिए *टेक्टोना ग्रांडिस* के परिणामों के साथ लिए गए हैं। इन परिणामों से पता चलता है कि *एरोकेरिया*, नीम और *जैकेरेण्डा* की कार्यशीलता कुल मिलाकर सागौन से श्रेष्ठतर है। इन पर हाथ से और मशीनी औजारों से काम करना सरल से बहुत सरल तक है।

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ECONOMIC FOREST RESOURCES OF GARHWAL-KUMAUN HIMALAYA

P.S. NEGI*

Wadia Institute of Himalayan Geology,
Dehra Dun (India)

Introduction

Uttrakhand covering Garhwal and Kumaun Himalayas lies between 77°34'27" E and 81° 02'2" E and between 28°23'24" N and 31°27'50" N, covering an area of 53,220 km² (equal to about 17.89% area of State) with a population of 4,815,326. The river Tons separate it from Himachal Pradesh in the west and river Kali in the east from Nepal; starting from foot hills in south it extends up to the Indo-Tibetan international boundary in north. The area is marked by a variety and complex phenomenon like vegetation, wildlife and geology with its own distinctive peculiarity even culturally too.

Climate

A variety of climates from tropical to polar type can be seen in the region mainly because of altitude and micro-climate complexity. Winters are very severe and snowfall is caused by winter depression commonly between January and March which occurs down to 1500m. The minimum and maximum temperatures ranges from 14.11 to 55.11°C in the region investigated. The annual rainfall ranges from 700 to over 2000 mm, the rainy season is flanked with a warm and cool dry period. The area is markedly affected by summer monsoon, arrival of which heralds the onset of rainy season in the later part of June, and its retreat by the end of September coincides with lowering of temperature and gradual advent of the winter season. Infrequently winter showers occur during December-February.

Soils

Depending upon ecological setting, soils vary from slope to slope and valley to valley. The Alpine zone extending above 3000 m has soils of glacial origin with naked rocks and meadows. These soils are mostly granitic sandy loam in nature. In the cool temperature and cold region (1800-3000 m), brown deciduous forest soils and grey coniferous forest soils, which are glacial and fluvio-glacial in origin, predominate. The brown forest soils generally varying from loam to clayey loam are fairly widespread in the warm temperature and the subtropical zones (900-1800 m). Alluvial soils are most common in the tropical zone (900 m). These are mixed with boulders, gravels and pebbles in the Siwalik Valleys, Duns and Bhabar region. Soils of the region are quite thin layered stoney and poor in fertility.

* Presently at Computer Data Centre, D.M. Office, Pauri (U.P.)

Vegetation

As the area of study is characterised with variety of climate types, flora is also correspondingly different types in different parts. Forests dominate the phytogeography and also constitute a most valuable natural wealth of the region. Champion and Seth (1968) have studied the complicated structure of the flora of the region in details. The region can be divided into following three broad vegetational zones, mainly on the basis of climate and altitude, with some overlaping of transitional features.

(i) *Submontane or Lower Region (Tropical and Sub-Tropical)*: This zone ranges roughly between 300 to 1200 m in height, which cover the sub-Himalaya tract and is the extension of sub-deciduous forest belt of Bhabar areas. It is dominated by deciduous-sub-deciduous types. *Shorea robusta* (Sal) is the most significant species found generally upto the elevation of about 750 m on southern slopes and 1200 m on northern slopes. *Dalbergia sissoo* are dominant along the river beds, while in more moist soils, dominants are *Cedrela toona* (Tun), *Ficus glomerata* and *Eugenia jambolana*. In isolated patches of grasses, there are present trees of *Acacia catechu, Butea monosperma, Bombax* spp., *Adina cordifolia* and *Holoptelea integrifolia* (Kanju) etc. In dry belt towards west, *Shorea robusta* is replaced by such xerophytes as species of *Zizyphus, Carissa, Acacia* etc. With Thorny succulent Euphorbias on slopes. *Pinus roxburghii* begins to appear at 1000 m to 1600m. Ground vegetation is poor.

(ii) *Montane Zone (Temperate)*: It covers an altitude of approximately 1200 m to 2000 m and receives maximum precipitation both in summer and winter. This middle zone is dominated by conferous forest. *Pinus roxburghii* generally replaced by *P. wallichiana* from 1500-3100m. *Cedrus deodara* is quite abundant forming pure forest stand. At these altitudes *Quercus leucotrichophora* also grows as separate patches. In the inner Himalayas species of *Betula* (Bhojpatra), *Salix* and *Populus* are abundant on certain soil types. At higher altitudes *Aesculus indica* (Panger), *Quercus semecarpifolia, Q. dilatata* along with Conifers like *Abies pindrow,* (Silver fir), *Pices morinda* (Spruce), *Cupressus torulosa, Taxus baccata* etc. are most common components of vegetation, *Rhododendron campanulatum* grows at higher altitudes. In inner valleys on dry mountains, *Pinus gerardiana* is also found, but it is not always the case every where and the species is somewhat local in the inner arid valleys of the Himalaya around the Niti pass in Garhwal.

(iii) *Alpine Zone* : This upper most zone which includes sub-alpine and alpine zones ranges from 2000 to 4000 m. It is the limit of tree growth at about 3900m known as timber line, where the plant's height is considerably reduced. Plants are mostly dwarfed and shrubs and grasses are cushion shaped. At about 4800m and above snow line, plant growth is almost nil. On lower levels of this zone some *Rhododendrons, Betula utilis* and small *Juniperus* are present. There are many types of herbs, with short period of vegetative growth and flowering above this zone. These include *Primula, Potentilla, Polygonum, Geranium, Saxifraga, Aster* etc.

Geology and Vegetation

According to author's practical observation and some recent studies, it has been found that rocks influence the distribution of forest type. Goel and Singh (1981), on the basis of serial photographs of a part of

Uttrakhand Himalaya concluded that *Shorea robusta* forest and Shorea miscellaneous forests occur predominantly on sand stones, shales of the Siwalik system, and Nagthat volcanics, respectively; *Pinus roxburghii* on Nagthat quartzite, and shales of Krol Group of lower altitude, and *Quercus leucotrichophora* occurred on Ramgarh porphyry gneiss and at higher altitude in shale of the Krol Group. However Krol limestone was predominantly covered with *Quercus dilatata*. Soil under *Cedrus deodara* was leached and acidic in nature, while oaks appeared to be conductive to formation of brown forest soil. Moreover the soil carrying *Abies pindrow, Picea smithiana* and *Quercus semecarpifolia* are akin to *Q. dilatata* in respect to Iron, Aluminium, Calcium and Potassium but differ by having greater content of Magnesium, Phosphorus, Manganese, Organic matter and Nitrogen even as compared to *Q. leucotrichophora (Q. incana)*.

The glittering peaks and valleys of Garhwal-Kumaun Himalaya are rich in plant heritage but unfortunately this resource has received very little attention for small scale industrialisation to the local people.

In Western Himalayas, there is a general zonation of vegetation from lower to higher altitudes. The successive zone of vegetation from base to upwards are tropical, temperate and alpine, however, there are practically no sharp boundaries between these vegetational zone due to difference in topography, soil and geology.

Thus on Himalayas Western as well as Eastern, the effects of environmental factors together with altitude becomes quite evident after studying the vegetational zones of different altitudes.

A large variety of economic plants given below of this region can largely contribute to economic amelioration of the local people. Author has studied the forest flora and cultivated plants of the region for last three years and made possible efforts to explore it for small scale industrialisation.

Sports goods : *Morus alba* (Sahtoot), *Salix elagans* (Kadvi), *Pyrus pashia* (Mehal), *Adina cordifolia* (Haldu), *Flacourtia* (Kango), *Juglans regia* (Akrot), *Dalbergia sissoo* (Shisham), *Tectona grandis* (Teak), *Butea monosperma* (Dhak), *Ficus racemosa* (Gooler), *Cedrela toona* (Tun).

Wood for carving and engraving : *Juglans regia, Oliea glandulifera* (Gald), *Alstonia scholaris* (Satian), *Wrightia tomentosa* (Dudhi), *Embelica officinalis* (Amla), *Buxus wallichiana* (Papri), *Aesculus indica* (Panger), *Acer oblongum* (Kirmola) etc.

Mat and Basket Industry : *Arundinaria* spp. (Ringal), *Salix elegans* (Kadvi), *Morus alba* (Sahtoot), *Typha* spp. (Patera), *Grewia oppositifolia* (Bhimal), *Musa paradisica* (Kela).

Softwood for musical instruments and toys : *Leycesteria formosa* (Bhuj-nali), *Buxus sempervirens* (Papri).

Mine frame work : *Shorea robusta* (Sal), *Terminalia tomentosa* (Sain), *Acacia nilotica* (Babul).

Picture frams : *Dalbergia sissoo* (Shisham), *Bombax malabaricum* (Semal), *Adina cordifolia* (Haldu).

Pen holders and pencil slats : *Cedrus deodara* (Deodar), *Juglans regia, Cedrela toona* (Tun), *Pinus excelsa* (Kail), *Bombax malabaricum* (Semal), *Adina cordifolia* (Haldu).

Bobbins and Shuttles : Adina cordifolia (Haldu), *Carpinus viminea* (chamkharik).

Sericulture : *Morus alba, Quercus incana* (Banj), & *Q. dilatata* (Moru) etc.

Match splinters etc. : *Bombax malabaricum, Pinus longitolia* (Chir) and Tropical pines, *Ailanthus* spp., *Populus* spp. (Safeda) etc.

Wood for packing case : *Corylus colurna* (Kapasi), *Mangifera indica* (Aam), *Alnus nepalensis* (Utis), *Ficus religiosa* (Pipal), *Pinus* spp., *Butea* spp. (Dhak)

Walking sticks : *Zanthoxylum alatum* (Timur), *Fraxinus* spp. (Ang), *Quercus dilatata* (Moru), *Bamboo* spp. (Bans) etc.

Fibre for ropes, Cordages and Stuffing etc. : *Grewia oppositifolia* (Bhimal), *Agave sisalana* (Banskera, Rambans), *Helictres isora* (Marorphal), *Hibiscus sadariffa* (Patsan), *Boehmeria rugulosa* (Genthi), *Cannabis sativa* (Bhang), *Linum usitatissimum* (Alsi), *Musa* spp. (Kela), *Calotropis procera, Saccharum munja* (Munj), *Andropogon* spp. (the spear grass) etc.

Rifle parts and gun stock : *Juglans* spp. etc.

Tobacco pipes : *Acacia nilotica* (Babul), *Dalbergia* sissoo (Shisham).

Bent wood articles : *Celtis orientalis* (Kharik), *Morus alba, Dalbergia sissoo* (Shisham).

Boot last and shoes heels : *Zizyphus jujuba* (Ber) etc.

Brush Back : *Dalbergia sissoo* (Shisham), *Adina cordifolia* (Haldu).

Battery seprators: Adina cordifolia (Haldu), *Ficus excelsa* (Kail), *Michelia champaca* (Champak).

Paper pulp : *Broussonetia papyrifera* (paper mulberry), *Daphne papyracea* (Satpura), Tropical pines, *Cannabis sativa* (Bhang), *Eucalyptus* spp., *Bambusa* spp. (Bans), *Picea smithiana* (Rai) etc.

Gum, resin, oil etc. : *Pinus lognifolia* (Chir), *P. wallichiana, Cedrus deodara* (Deodar), *Bauhinia retusa* (Semla), *Moringa pterygosperma* (Saijan) *Butea frondosa* (Dhak), *Acacia* spp. (babool), *Shorea robusta* (Sal), *Prunus spp.* (Aru, Khoomani), *Melia azedarach* (Bakain), *Anogeissus latifolia* (Bakli), etc.

Tanin : (From bark, leaves etc.) *Acacia* spp., *Quercus* spp. (Banj, Moru etc.) *Terminalia arjuna* (Arjun), *T. chebula* (Har), *Shorea robusta* (Sal), *Cassia fistula* (Amaltas), *Zizyphus jujuba* (Ber), *Cinnamomum tamala* (Dalchini), *Anogeissus latifolia* (Bakli) etc.

Dyes : (From wood, leaves, flowers and fruit etc.) *Acacia catechu* (Khair), *Artocarpus integrifolia* (Kathal), *Indigofera tinctoria* (Neel), *Lawsonia inermis* (Mehdi), *Curcuma longa* (Haldi), *Rubia cordifolia* (Manjit), *Berberis aristata* (Kilmora), *Terminalia tomentosa* (Sain), *Mimusops elengi* (Maulsari) *Butea frondosa* (Dhak), *Nyctanthes arbortristis* (Harsingar), *Mallotus phillipensis* (Rohini) etc.

Fuel : *Pinus* spp. (Chir etc.) *Quercus incana* (Banj), *Q. dilatata* (Moru), *Rhus parviflora* (Tungla), *Eucalyptus* hybrid, *E. citriodora, Robinia pseudocacia* (False acacia), *Populus casale, P. deltoidea, Grewia oppositifolia* (Bhimal) etc.

Leaf fodder : *Quercus incana* (Banj), *Q.dilatata* (Moru), *Bauhinia retusa* (Semla), *Grewia oppositifolia, Celtis Orientalis* (Kharik), *Ficus palmata* (Bedu), *F. Cunia* (Khina), *F. nemoralis* (Parphuta), *Melia azedarach* (Bakain), *Morus serrata* (Kemu), *Populus ciliata* (Poplar), etc.

Oil extraction from seeds : *Brassica* spp. (Rai, sersoan), *Sesamum indicum* (Til), *Prunus* spp. (Choolu, Adu etc.). *Helianthus annus* (Sooraj Mookhi), *Ricinus communis* (Arandi), *Linum usitatissimum* (Alsi), *Shorea robusta* (Sal) etc.

This area represents the reservoirs of medicinal and aromatic plants, frequently known to occur in nature and cultivated according to their suitability as per as soil and climatic conditions. A detailed list of important medicinal plants with their medicinal value is given in Table 1.

The medicinal plants in the form of roots, herbs, bark etc. are mostly exported to other States for further processing. These plants can be collected from the wild, thereby giving employment to people or can be cultivated in systematic and planned way according to the demand of particular plant in such a way as to bring immediate economic relief to the local inhabitants. Some people think that due to increasing development of synthetic products, the role of plants in medicine is ending. An analysis of common prescription in the even most advanced countries like U.S.A. has shown that it is a myth. Nearly 50% of the constituents in present day prescriptions are natural products, and knowledgeable sources like experts in pharmacology, believe that in next decade there will be a big increase in use of plant products in medicines.

The medicinal plant industry in our country is not very organised at present, but considerable work is in the hand of Botanical Survey of India, Central Council for Research in Indian Medicine and Homeopathy, central Indian Medicinal Plant Organisation and Regional Research Laboratories for distribution, new uses, method of collection, storage and agronomy, etc. Many important but less known medicinal plants may be occurring in the unexplored areas of U.P. hills which are frequently known to villagers and they have been using those for many diseases. Many other valuable plant species which have been used in various diseases since very long time in this region are the species of *Potentilla, Anemone, Achilles, Calamintha, Cirsium, Codonopsis, Delhinium, Geranium, Hyosocymus, Iris, Meconopsis, Origanum, Pedicularis, Podophyllum* (Ban Khakri). *Rhododendron* (Burans), *Spiraea, Thymus, Picrorhiza* (Karwai), *Nardostachys* (Mansi), *Valeriana* (Sumya), *Taxus* (Thunare), *Acorus* (Baj), *Hydeobis* (Kachoor), *Archeodel trifolia* (Salam panja), *Cedrus* (Deodar), *Centeela* (Brahmi), *Gentiana* (Trapman), *Thalictrum* (Pealmola), *Plumbag* (Chitrak), *Levia* (Moonj), *Xenthoxylum* (Timru), *Vergenia* (Silfar), *Myrica* (Kaphal), *Hyoaymus* (Jawan), *Betula* (Bojpatra), *Trigonella* (Methi), etc.

Suggestion & Guidelines for Scientific Development

Unless the development plans for the hill area are based on the understanding of their specific problems and characteristics there is every possibility of their not achieving the desired results, Such a policy must take following lines into consideration for forest resource and its utilization.

(1) Since the conservation with ordinary trees such as for fuel and fodder does not

TABLE 1:

Medicinal Plants with their uses

Common Name Local Name	Botanical Name	Uses
1	2	3
Amla	*Embelica officinalis*	Scurvy, vomiting, thirst, leprosy, piles and anaemia lucorrhea, etc.
Ateesh atibisa	*Aconitum nepellus*	Fever, chloera etc.
Bahera	*Terminalia bellirica*	Indigestion and vomiting etc.
Bhang	*Cannabis sativa*	Kapha, Leprosy, diarrhoea, neuraliga and eczema etc. Appetizer and astrigent.
Blue violet	*Viola odorata*	Purgative, expectorant (cough relieving) eye disease and chronic fevers etc.
Chirayata	*Swertia chirayita*	Blood impurities, joint pain, chronic fever, leucoderma, liver disorder, vomiting in pregnancy, it remove intestinal worms and is a safe laxative.
Dalchini	*Cinnamomum zeylanicum*	Diarrhoea, bronchitis, urinary and heart disease.
Datura	*Datura stramonium*	Eye pain, headache, gonorrhoea (infection of mucus membrane of genital tract) etc.
Dioscorea	*Dioscorea deltoidea*	Used for carticosteroids, sex hormones and oral contra-ceptives.
Eucalyptus	*Eucalyptus globulus*	Asthama, bronchitis, antiseptic and repulls the insects and masquitoes.
Adrak	*Zingiber officinale*	Disease of heart and Throat, indigestion, vomiting, pains etc.
Isbaghol	*Plantago ovata*	Kapha, liver, disorder, dysentery and chronic diarrhoea, renal disorders, etc.
Kachnar	*Bauhinia variegata*	Syphilis, leprosy, Ulcers etc.

(Contd.)

1	2	3
Kingore	*Berberis asiatica*	Ulcer, dysentery, eye drops etc.
Kuth	*Saussurea lappa*	Disease of blood, liver, kidney, cough headache, hysteria and fevers.
Pudina	*Mentha arvensis*	Antispasmodic carminative, stomachic, refrigerent, diuretic etc.
Neem	*Azadirachta indica*	Ulcer, eczema, eye and skin disease, cough, asthma, piles and urinary discharges.
Post	*Papaver somniferum*	Urgent pain relieving and sleep inducing, respiratory trouble, ulcer, gastritis, sedative etc.
Sag-angur	*Atropa belladonna*	Rheumatism, neuralgia and lumbago, acute ulcer etc.
Sarpgandha	*Rauvolfia-serpentina*	High blood presser tension fear, distroying and expelling worms of intestine.
Amaltas	*Cassia fistula*	Throat, respiratory liver and eye disease, appetizer and strengthen liver.
Stone apple	*Aegle marmelos*	Diarrhoea, dysentery and irritations of the alimentory canal etc.
Tulsi	*Ocimum sanctum*	Malaria, abdominal disease and liver disorder, vomiting and skin disease.
Haldi	*Curcuma longa*	Pains (extranally) and as a stimulant (internally).
Tut	*Ephedra gerardiana*	Nasal and bronchail congestion, antipyretic, anticardiac etc.
Bansa	*Adhatoda vasica*	Cough, bronchits, asthma, loss of memory, blood impurities, dysentery, etc.

Table 2

Circlewise Resin Production Since 1976-77

Year of Production	Kumaon Circle		Garhwal Circle		Tehri Circle		Western Circle		Total	
	Quantity (Qtls.)	Value (Rs.)	Quantity (Qtls.)	Value (Rs.)	Quantity (Qtls.)	Value (Rs.)	Quantity (Qtls.)	Value (Rs.)	Quantity (Qtls.)	Value (Rs.)
1976-77	153092	23900174	28339	4563515	27722	5156685	1003	160279	210156	33780653
1977-78	115977	23704600	24175	5635001	14617	2923523	1005	206098	155774	32469222
1978-79	101601	29667492	16604	4705243	10395	2361990	1009	265824	129609	37000549
1979-80	106117	35327075	18199	6607841	16834	7530445	1197	538650	142347	50004011
1980-81	112172	40546910	19964	8718392	36377	17112093	1143	548640	169656	66926035
1981-82	82800	32890766	21701	8974653	35742	16517991	998	499000	141241	53882410

yield early returns, extensive planting for trees and shrubs of economic importance on which small cottage industries such as handsome fiber and paper pulp, drug and aromatic plants, furniture, toys, packing cases, baskets, walking sticks, wood carving, wood engraving, sericulture, charcoal and active carbon, sports goods, wood wool, chip board, softwood could be selected.

(2) Due to the limited holding, initial cost and late returns with natural calamities like heavy storm, hail etc. and lack of proper transportation facilities, horticulture could not get the required economic boost. Inter cultural operation on unirrigated terraces with fruit plants and off season vegetables and cash crops is perhaps one solution. This system often called as three dimensional forestry would satisfy the need for conservation.

(3) Extraction of some of the minor forest products and cultivation of economic plants, preferably indigenous species can be collaborated with present forest management and development programme. Most of the species can be grown as under-growth or on forest fringes thereby deducing cultivation and supervision cost. Elimination of some of the intermediaries between the actual grower and the consumer is necessary. Many minor forest products are being collected and sold at cheaper rates to intermediaries who "export" them to far off places in India and reap lion's share of profit in this category. In this case mention can be made of the leaves and bark of *Cassia*, roots of *Berberis* and seeds of Sal etc.

(4) Fiber and pulp yielding plants like Bomboos, Daphne etc. are abundant in some of the areas of this region. Paper mills can be established in this area but care should be taken that natural ecosystem may not be disturbed. Squash can be obtained from beautiful flowers of *Rhododendron* (Burans) which grow plenty in this region.

(5) Proper development of forest resource in hill area will go a long way towards faster economic development of the region as a whole. More emphasis should be given to indigenous plant species and on growing varieties of trees which are of great industrial and economic importance. Farmers should be encouraged to grow Poplar.whose plantations are estimated to yield an additional 60,000 to 70,000 m^3 of high class wood for match industries; it is fast growing and high yielding tree which also can be planted along with agricultural crops.

(6) Resins which are important plant exudates used for adhesive purpose, paint, medicine, cosmetics and finishing textile products, etc., produced by the oxidation of various essential oil in plant tissues, chiefly obtained by pine which is a maximum producer of resin in India, can have good setup of scientifically well developed resin-industry. The circlewise annual production of resin in the region can be seen in Table 2. Tanins are of a very great economic value because of their ability to unite with certain type of Protein like those of animal skins (hides) to form strong, flexible, resistant and insoluble material called leather. Tannins can be obtained from bark of *Acacia, Quercus, Terminalia,* Sal, *Cassia* etc. which constitutes the natural flora of the region.

(7) The ecology of the Himalayan region provides bounty for certain areas in certain ways. The bounties are valuable potential source and endowments which get localized and therefore, constitute unique resources, It is these resources which needs to be utilized to the maximum extent. The prin-

ciple of specificity applied in IADP areas is also applicable to other field of activities, for example the potato of Kanatal (Tehri Garhwal), Apple and Bean of Hersil (Uttarkashi), Chilli, Ginger of Ramnagar (Nainital) and Agrakhal (Tehri Garhwal) are the products of specific endowments of the respective areas.

(8) One of the main set-back of the area is lack of cold storage facilities, villagers sell their seasonal products like fruits, vegetables etc. at cheaper rate because they could not store their products for off season. For example at the time of apple season the best variety of apple can be purchased from local people by rupees two or three per kg which goes to Indian plains for storage and again returns to same area with rate of six-seven rupees per kg.

(9) Recently an amazing and successful experiment of Solar energy for electrification of two villages in "Rath" area of Pauri District has been done. This area is quite undeveloped and was not electrified till now. The people of this area are now fortunate to see direct national telecasts. This alternate source of energy will be a boon for the people of hilly terrain and can be used in all the areas where electrification is not easy by other means.

(10 In addition to those mentioned above, the region is rich in beautiful orchids and bulbous plant also, some of these plants have great demand both inside and outside of the country, if the villagers can be trained to cultivate and propagate these orchids and bulbs in a systematic way, either as under growth in forest or on the trees, they will get some economic relief. These additional source of income can help in diverting the forest dwellers from their present total economic dependence on shifting cultivation or other means of destruction of forest.

SUMMARY

The economic forest resources of the Garhwal-Kumaun Himalaya (Uttrakhand) has been explored in the present paper with special reference to medicinal and other economic plants which may be used to boost the economy of the region and in providing local employment. Since the principal climatic factors are influencing mountain vegetation, therefore, the paper also throws light upon those factors whose study would be useful in reflecting more clear and distinctive idea about the areas of the study.

गढ़वाल-कुमाऊं हिमायल क्षेत्र के आर्थिक महत्व के वन संसाधन

पी०एस० नेगी

सारांश

गढ़वाल कुमाऊं हिमालय क्षेत्र (उत्तराखण्ड) के आर्थिक वन संसाधनों को, औषधीय और आर्थिक महत्व के अन्य पादपों के विशेष संदर्भ में, इस अभिपत्र में प्रस्तुत किया गया है। ये पादप इस क्षेत्र की अर्थव्यवस्था उन्नत बनाने और स्थानीय लोगों को रोज़गार देने के लिए उपयोग में लाए जा सकते हैं। जलवायु के प्रधान कारक पर्वतीय पेड़-पौधों को भी प्रभावित करते हैं इसलिए इस अभिपत्र में इन कारकों पर भी प्रकाश डाला गया है जिनका अध्ययन करना अध्ययन किए गए इस क्षेत्र के बारे में स्पष्टता और विशिष्टता से विचार करने में उपयोगी रहेगा।

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A STUDY ON THE PERIODICITY OF FOLIAGE DISEASES OF *ALBIZIA LEBBEK* AND CONTROL OF *CAMPTOMERIS* LEAF SPOT IN NURSERY

M.D. MEHROTRA, S.N. KHAN, R.K. TIVARI AND B.M. MISRA

Division of Forest Pathology,
Forest Research Institute, Dehra Dun (India)

Introduction

Albizia lebbek Benth. is an important trees species which grows naturally in Central and Southern India. It is one of the preferred species being planted under Social Forestry Programme in the country including Northern India.

During periodic surveillance of forest nurseries carried out from 1988-90 at Lachiwala, Karuapani and Satayanarain, Dehra Dun Forest Division; Kalsi, Chakrata Forest Division; Bhojipura, Clutterbuck Ganj in Bareilly Social Forestry Division in Uttar Pradesh and Chichrauli, Ambala Forest Division in Haryana State, the authors observed nine fungal diseases namely, damping off caused by *Fusarium oxysporum* Schelcht.; leaf spots caused by *Cercospora albizziae* Kar & Mandal, *Colletotrichum* sp., *Pleiochaeta setosa* (Kirchn.) Hughes, *Camptomeris albizziae* (Petch) Mason and *Epicoccum nigrum* Link; leaf web-blight caused by *Rhizoctonia solani* Kuhn anamorph of *Thanatephorus cucumeris* (Frank) Donk, leaf blight caused by *Alternaria alternata* (Fr.) Keissler and *Periconia* twig blight in *A. lebbek* which caused damage to the foliage to varying extent. The four diseases, *Epicoccum* and *Pleiochaeta* leaf spots, *Alternaria* blight and *Periconia* twig blight, are new for this tree species and they will be published elsewhere.

A disease calendar denoting the appearance and persistence of the disease during the growing season is prepared. In view of the wide occurrence and high disease incidence of *Camptomeris* leaf spot in nurseries in Doon Valley, in particular, suitable control of the disease is evolved, the results of which are reported in this paper.

Material and Method

The seedlings of *A. lebbek* were raised in polypots in May, 1989. Twentyeight experimental plots, each containing 50 plants were arranged in five rows. The outer 26 plants in each plot were considered as buffer.

A completely randomised design was adopted for the allocation of seven treatments viz. Blitox (Copper oxychloride), Captafol [Cis-N-(1, 1, 2, 2,-tetrachloroethylthio)-4-cyclohexene-1, 2-dicarboximide], Topsin-M [1, 2-bis (3-methoxycarbonyl-2-thioureido) benezene], Dithane M-45 (Manganese ethylene-bisdithiocarbamate plus zinc), Ziram (Zinc dimethyldithiocarbamate), Jkstein (Methy 1-2-benzimidazole carbamate) and control.

Each treatment was replicated four times.

The spray schedule of fungicidal application started in the first week of September and the fungicides were applied three times at an interval of twenty days. The disease at New Forest appeared late hence the delay in the first application of the fungicides. Final observation were recorded in the first week of December.

The disease index of the plots was calculated on the basis of randomly selected five plants out of 24 inner plants. Observations recorded for disease index include: total number of rachilla in each plant, number of infected rachilla, total number of leaflets and number of infected leaflets per rachilla. Per cent disease index was calculated on the basis of number of infected leaflets in each test plant. The average percent disease index of a plot was further calculated from the disease index of five randomly selected plants. The calculations of plant disease index were made on the basis of percentage of diseased leaflets in each rachilla.

$$\text{Percent disease index} = \frac{(P_1 + P_2 \ldots\ldots\ldots + P_n) \times 100}{(n \times 100)} = \frac{Pi}{n}$$

(where n is the number of rachilla in a plant and P is the percentage of diseased leaflets).

Percentage of disease control for each fungicide was calculated from the values of mean per cent disease index as under:

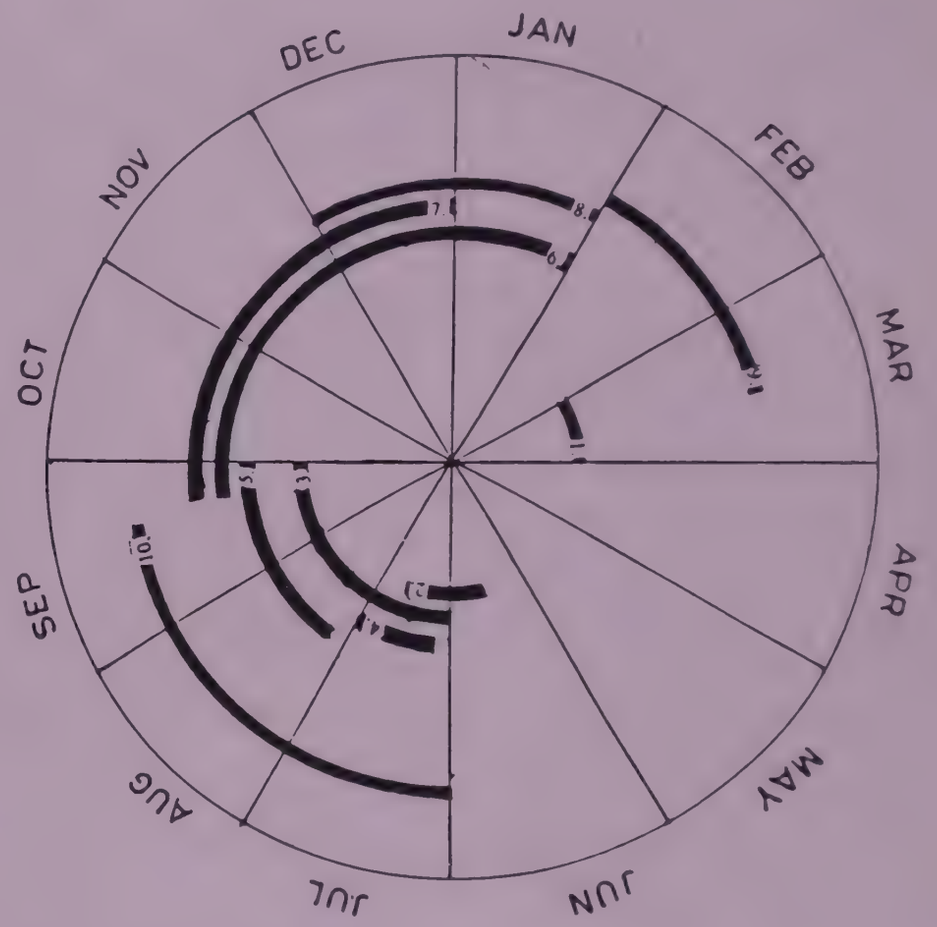
$$\text{Percent disease control} = \frac{\text{Disease index in control} - \text{Disease index (in treatment)} \times 100}{\text{Disease index in control}}$$

Disease Calendar

The disease calendar is prepared in order to know at what time during the growing season the diseases appear and how long they continue inflicting the seedling crop in the nursery (Fig. 1)

The first disease to appear was damping off caused by *F. oxysporum*. It appeared in March causing both pre-emergence and post-emergence damping off. The next disease to appear was *Colletotrichum* leaf spot. The disease appeared in June after a few monsoon showers and it was of short duration of 4-5 weeks. *Periconia* twig blight appeared in around 1st week of July and the disease continued for barely 2-3 weeks. Subsequently *Rhizoctonia* leaf web blight appeared in July after the regular monsoon rains set in and continued throughout the humid months. Warm and excessive humid conditions were conducive to disease development. The disease started declining in September and with lowering of atmospheric temperature and declining of precipitation (Mehrotra, 1989). It is almost during the same period the blighted foliage invariably showed fruiting structures of *Colletotrichum* sp., *Mycosphaerella albizzias* and its anamorph, *Fusarium* sp. and rarely of *Elsinoe* sp. These fungi appeared to be weak parasites or secondary invaders. *Camptomeris* leaf spot appeared in around mid-August and continued till leaf fall. *Pleiochaeta* leaf spot appeared around first week of August and continued till September. The appearance of *Cercospora* leaf spot was recorded in mid-August and the disease continued inflicting leaves till December. *Alternaria* leaf blight appeared in December and the pathogen was quite aggressive all through December and January. Wetting of leaf surfaces due to copious dew

Figure 1



1. DAMPING-OFF BY FUSARIUM OXYSPORUM & RHIZOCTONIA SOLANI
2. COLLETOTRICHUM LEAF SPOT
3. RHIZOCTONIA LEAF WEB BLIGHT
4. PERICONIA TWIG BLIGHT
5. PLEIOCHAETA LEAF SPOT
6. CAMPTOMERIS LEAF SPOT
7. CERCOSPORA LEAF SPOT
8. ALTERNARIA LEAF BLIGHT
9. EPICOCCUM LEAF SPOT
10. WEAK PATHOGENS / SECONDRY INVADERS – MYCOSPHAERELLA ALBIZZIAE, PHOMOPSIS ALBIZZIAE, FUSARIUM SP. AND ELSINOE SP.

A Disease Calendar for Foliage Pathogens of *Albizia lebbck* in U.P. Nurseries.

formation in shady locations increased severity of the disease. The last disease to appear was *Epicoccum* leaf spot in February and the disease continued till mid-March.

Chemical control

The results presented in Table 1 show that the per cent disease index in different treatments is highly significantly different (P .001). The values of per cent disease index in treatments viz. Topsin M, Jkstein and Dithane M-45 are very low and differ significantly from those of control plots. However, they do not differ within treatments. On the other hand, the value of per cent disease index in treatments viz. Blitox, Ziram and Captafol do not differ significantly from control. Percentage of disease control is highest in Topsin-M treated plots (96.4%) followed by Jkstein (93.0%) and Dithane M-45 (90.4%).

Discussion

The disease calendar gives information about the occurrence and duration of different diseases in the nurseries in western part of Uttar Pradesh. This is helpful in understanding the epidemiology of the diseases and working out their control.

Camptomeris leaf spot is an important disease which occurs for a long duration during the growing season of the plant. The pathogan has earlier been recorded to attack 7 different species of *Albizia* including *A. lebbek* (Agnihothrdu, 1962). In view

Table 1

Effect of different fungicides on Camptomeris leaf spot as represented by mean disease index per cent and per cent of disease control.

Treatment with dosages	Mean Disease Index Per cent		
	Original scale	Transferred scale log (x+1)	Disease control (%)
Blitox - 0.20 %	21.25	1.34739	55.7
Captafol - 0.20 %	25.96	1.43080	45.9
Topsin M - 0.10 %	1.71	0.43221	96.4
Dithane M-45 - 0.20 %	4.63	0.75050	90.4
Ziram - 0.20 %	22.25	1.36638	53.7
Jkstein - 0.10 %	3.35	0.63892	93.0
Control (without fungicide)	48.03	1.69644	
Significance			(P .001)
CD at P = 0.05		0.41617	
P = 0.01		0.50657	
P = 0.001		0.76486	

of the severity of the disease during winter months it became all the more necessary to keep the disease within the economic injury level and this has been achieved by foliar application of fungicides as prophylactants. From the experimental findings it may be concluded that the systemic fungicides namely Topsin-M and Jkstein followed by non-systemic fungicide, Dithane M-45 proved effective against the disease. Three to four applications of any of the above effective fungicides depending on the development of the disease in mid-August/first week of September are recommended for disease management.

Acknowledgement

The authors express their sincere thanks to Shri D.S. Rawat, Scientist-SD for statistical analysis of the data and their interpretation.

SUMMARY

A disease calendar for nine fungal diseases of *Albizia lebbek* is prepared for the first time. This will help in management of the diseases of this important tree species in the nursery. *Camptomeris* leaf spot, an important nursery disease has been effectively controlled by the application of Topsin-M, Jkstein and Dithane M-45. Three to four applications of any of the effective fungicides at tri weekly intervals are recommaned for disease management.

अल्बिजिया लिब्बेक के पत्तों के रोग का कालिक अध्ययन तथा
कैंप्टोमेरिस पत्ता दाग का रोपणी में नियंत्रण

एम0डी मेहरोत्रा, एस0एन0 खान, आर0के0 तिवारी व बी0एम0 मिश्र

सारांश

प्रथमबार *अल्बिजिया लिब्बेक* के कवक रोगों की रोग सारिणी बनाई गई। यह रोपणी में मुख्य वृक्ष जातियों के रोग नियंत्रण में सहायक होगी। *कैंप्टोमेरिस* पत्तों पर दाग जो एक मुख्य रोपणियों का रोग है, टॉपसिन-एम, जैक्सटीन तथा डीथेन एम-45 अपनाकर सफलतापूर्वक नियंत्रित किया गया। तीन से चार बार अपनाकर किसी भी असरदार रोगनाशक से तीन सप्ताह के अन्तरकाल में रोग नियंत्रण के लिए सुझाया गया है।

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RESEARCH NOTE

A LEAF SPOT DISEASE OF *FICUS RELIGIOSA* AND ITS CONTROL

During the survey of diseases in the forest plantations at Bhubaneswar and Jabalpur a severe leaf spot disease of *F. religiosa* was noticed. This infection was also noticed in the leaves sold in the local market as fodder. It was caused by a pathogen *Colletotrichum gloeosporioides* (Penz) Sacc. The losses were very severe as the fungus affect the plantations and the leaf fodder. The disease has not been reported from Orissa (Bilgrami *et al.*, 1979, 1981).

The infection developed in all over the lamina. Initially brown dot like scattered spots developed on the leaves which later coalesced to form larger spots. In some leaves the individual spots also increased in size. The spots are usually rounded or irregular. On ageing the lesion appeared discoloured or whitish in colour which later form shothole in the lamina. Black dot like sporodochia of the fungus also developed on the older spots. The spots were encircled by reddish brown margin. It has also been noticed that the intensity of lesions were more on the midrib, secondary veins as well as on the petiole of the leaves. The petiolar infection caused premature defoliation in the plants (Fig.1). The younger as well as middle aged leaves were susceptible to this infection. The lesions vary from 12 to 61 in the leaves (Table 1). The size of the spot vary from 2mm to 7mm.

On isolation, the diseased spots yielded the culture of *Colletotrichum gloeosporioides*. The isolation from the lamina and petiole were same. The organism developed profuse growth along with pinkish sporodochia of the fungus. The infection was vary severe from July to September. The high humidity and temperature favour the infection and conidiation on the lesions. The infection was minimized from November onward.

The pathogenicity of the organism was confirmed by inoculating the healthy leaves and petiole of *Ficus religiosa* by one week old culture of *Colletotrichum gloeosporioides*. The isolation were made during the month of August when the rela-

Figure 1

Leaf spots caused by *Colletotrichum gloeosporioides*

Table 1

Status of infection by Colletotrichum gloeosporioides in Ficus religiosa in Orissa.

Localities	% of Leaves infected	Average No. of lesion/ leaf	Average No. Sporo-dochia/lesion
Cuttack	35	59	55
Khondagiri	30	25	38
Somnathpur	25	23	35
Olakhand	20	50	30

tive humidity vary from 90 to 100 per cent. The infection developed within 10 days which later developed into the identical spots within 20-25 days of inoculation. Reisolation invariably yielded the same culture. The two fungicides Bavistin 0-2% and Dithane M-45 0.2% evaluated in the laboratory both the fungicides were effective in checking the growth of the fungus in the laboratory. On the basis of laboratory evaluation ten seedlings of *Ficus religiosa* were treated by both the fungicides. It has been observed that there was 100 per cent control by Dithane M-45 though Bavistin was also equally effective but in few leaves the lesion started developing after one month. It is recommended that Dithane M-45 0.2% may be sprayed for the control of anthracnose of *Ficus religiosa*. This fungicide is cheaper than Bavistin.

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Institute of Deciduous Forest,
Jabalpur (Madhya Pradesh)

V.S. Dadwal
and Jamaluddin

FOREST NOTES AND OBSERVATION

Precocious flowering in the saplings of *Eucalyptus tereticornis*.

Forest Department of Maharashtra has achieved a measure of success in raising *Eucalyptus tereticornis* plantations in Kolhapur District. Therefore, planting of *Eucalyptus* is being continued in Forest areas. Due to excellent extension works done by the Directorate of Social Forestry of Maharashtra and Nilgiri Utpadak Sangh of Nasik, planting of *Eucalyptus* (Mysore-gum) in farm lands is also increasingly getting popular. Forest Development Corporation of Maharashtra Limited (F.D.C.M. Ltd.) is also concentrating its efforts in greening the forest wastelands of Western Ghat in Kolhapur District by opening a Sub-Division at Gadhinglaj. F.D.C.M. Ltd. is raising afforestations in forest wastelands since 1988 by availing funds from Employment Guarantee Scheme and also from Compensatory afforestation scheme. F.D.C.M. Ltd., has raised 2910ha afforestation works in Kolhapur District from 1988 to 1991.

Figure 1

Precocious flowering in *E. tereticornis* saplings in Kolhapur District.

During 1990 rains, the Sub-Divisional Manager, Gadhinglaj has raised 40 ha afforestation in Survey No. 17, 18, 20, 225 & 226 of Naukud in Ajara range of Kolhapur District. This is one of the best afforestation works in this Sub-Division and raised around the hill slopes of historically important Fort called "Samangad". 74342 No. of seedlings of *Eucalyptus,* Australian Bahul, Ain, Shiven, Sissoo, Cashewnut etc. were planted in this area. The survival percentage as per October counting is 93%. 20,400 No. of *Eucalyptus* seedlings were planted. It is seen that Five saplings of *Eucalyptus* planted in June, 1990 were found flowered on 10-5-1991 (Fig 1). The same plants were again observed with formation of fruit set on 17-2-1992. It is thus a very rare phenomenon to see *Eucalyptus* saplings flowering when they are just less than two years old. It appears to us that this kind of precocious flowering is a freak in the population and may be due to genetical mutation. May we request the readers of *Indian Forester* to throw some light on the early flowering in the saplings of *Eucalyptus tereticornis.*

Yours faithfully,

F.D.C.M.Ltd, Thane Region,
Thane (Maharashtra)

K. Subramanian
Regional Manager
and
A.R. Purohit
Sub-Divisional Manager

Kolhapur Project Sub-Division,
Gadhinglaj, F.D.C.M.Ltd.
Gandhinagar, Gadhinglaj.
(Maharashtra)

From the Indian Forester One Hundred Years Ago

THE INDIAN FORESTER

August, 1892 (pp-307-309)

THE APPOINTMENT OF FORESTERS

There seems to me to be a failure in the system of appointing "Foresters". The rules insist on their having passed the Middle Class Examination, no doubt in order to secure men of some *general* education. Unfortunately, mere general education is by no means sufficient for men who have such technical duties as have foresters - duties too, absolutely demanding experience. Almost the only men available under this examination rule are schoolboys or bazar bred individuals with flowing robes and odorous of "hing" and "ghi" - Such creatures are, of course, impossible. Just fancy them controlling operations at a forest fire! The terror and hardships of a forest life are not for such as these. Give us straight men as hard as nails. If I quote my own Division as it was a short time ago, I shall give a good example of the "impasse" to which we often come. I had seven Ranges and four of them were held by Forest Guards - though three were lumped together into a Sub-Division under the Solitary Ranger I had. Foresters were not available from elsewhere and no single Forest-guard in the Divison had passed the Middle Class Examination.

To remedy this state of things I think the best system would be to abolish the Middle Class, and substitute a *Departmental* examination to come, as hitherto, at the step up to the Rs. 15 grade. In this departmental examination I would have a few heads to obtain fixed minima in which is a *sine qua non*, but among the remaining subjects deficiency in some heads should be able to be overcome by proficiency in others.

* For the important ranges of the future we are to have rangers appointed from the School, and, though I think more experience should be required of them, that is not what we are now considering - it is here only a question of the minor ranges to be held by foresters. My suggestion with reference to these is that no man should be appointed straight to a Forestership, but should begin as a guard and that every literate guard should be in a position to rise to Rs.40. This would give a continual stimulus to good work and honesty and the "be-umed" men - to whom the only object remaining is to make money dishonestly, would tend to disappear. But of course, this would only be possible if the compulsory subjects were very elementary - and I think they should be; for minor work what we chiefly want is sturdiness and experience.

The Middle Class Examination in these provinces was, I understand, as follows, this year:-

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* Note : Our correspondent can also get Foresters from the School. Just now, there are about six private students of the Vernacular Class all anxious for employment. - Hon. Ed.

Bhusa Bhasker -	Hindi reading apparently.
Gutka, 3 parts	(ditto)
Hunter's History	(in Hindi)
Geography	(ditto)
Euclid 2 books	(ditto)
Mensuration	(ditto)
Arithmetic	(ditto)
Chandrika Prakirt	(?)

I would suggest, as a substitute, the following subjects, those marked with an asterisk being the compulsory subjects;

* Reading in the vernacular.
* Writing in the vernacular.
Dictation in the vernacular.
Reading maps with intelligence.
Surveying up to the standard of a Patwari.
* Arithmetic-including Decimals and Rule of Three, but not the highest part of the subject.

General considerations as:-

Intelligence, *activity, power of control, *integrity, experience.

Thus provided only a guard got the required minima in the compulsory subjects, his being unable to make marks in such subjects as surveying, or dictation, might be counterbalanced by high marks in such heads as experience - or Power of Control, thus enabling really deserving men to get on. And I would further prevent clever but morally inferior men from advancing, by giving them *minus* marks in the moral subjects.

The Departmental Examination might be held in each Circle when necessary - under the orders of the Conservator during the recess season.

There are some other points in connection with the Protective Establishment which I think might be altered with advantage, though, no doubt, they are not of paramount importance.

One is that of uniform. I think this should be approximate as far as possible in all the provinces under the Government of India, for somehow I think this would increase *esprit de corps,* and smartness in minor arrangements certainly tends to raise the status of the Service and to make the men feel there is "izat" in belonging to it. Thus when I see a guard slovenly dressed, I tell him that if he doesn't know how to wear the Queen's uniform, the right shall be taken away from him.

The Forest guard's uniform of these provinces seems a passably good one and serviceable, though no doubt it might be improved upon. Perhaps for example a material of stronger texture might be found, and the men might have the option of having a woolen khaki-dyed uniform in cold weather. Then I certainly think "puttees" (of the same colour as the dark part of the puggri) should be insisted on - at least in the cold weather. The green edging always fades and look shabby and might without much harm be abolished. As to the dark green of the puggri, it would appear that no such thing as a green (save perhaps an awful pale green that is altogether impossible) that is fast-dyed is to be had and I would suggest pomegranate, which I believe could be used locally for re-dyeing (but am not sure). Boots, too, would certainly be most useful, but would have to be supplied by Government for they could not be got for less than Rs. 3-8 a pair. There would be no necessity to have square-toed boots three-sizes too large, like the North-West Provinces Police. It is most

ludicrous seeing a guard pick up his shoes and rush through thorns and over stones to catch a delinquent.

Another alteration I should like to see would be the abolition of the word "Guard". The good old English terms are "Ranger", "Forester" and "Verderer": we can dismiss the last, but I think it would be better to have Rangers, including in the term all the existing grades of Forester, and Foresters which could correspond to the present Forest Guards. In John's times and thereabouts, the men employed to guard the roval shikar forests were I believe called "King's Foresters". The word "guard" recalls Military ideas and for goodness sake let us not pretend to be Military when we are not - the more especially as we have such a rich and picturesque body of tradition on which to draw.

A.G. HOBART-HAMPDEN

LETTER TO THE EDITOR

To

The Hony. Editor,
Indian Forestor
P.O. New Forest,
Dehra Dun (U.P.)

Dear Sir,

This has a reference to Shri Mathur's note on rat menace in rubber plantation published in your journal of April 1991. This menace was first detected in 1975 in a three-year old rubber plantation at Sachiramburi. Mercifully, it was limited to only a few patches and did not recur as the plantation grew older. A few of this particular species of rat were also captured.

Since 1976, after the Tripura Forest Development and Plantation Corporation was setup,damage to any rubber plantation raised by the Corporation (through its efforts Tripura is now the fourth largest rubber growing State in India) was not reported in the Board meetings, of which I was a member. From the behavioural pattern of this species of rat, it appears that it is highly secretive, alert and nocturnal in habit (does it make ground inspection of its victim, about its location before digging in ?).

Recently, I read an article in SPAN (USIS publication) about American farmers keeping owls as pets to eliminate field rats damaging their standing crops when conventional control measures become ineffective. From my personal experience, I believe, male cats as pets may be useful not only for their exceptional rat-killing instinct but to make frequent forays to neighbouring fields and forest bushes at night as well, obviously for hunting rats.

Your faithfully,
Sd/-A.K. Ghosh, IFS (Retd.)
Flat No B/9-6, Purbasa
160, Maniktala Main Road,
Calcutta (West Bengal)

Books on Social Forestry From BAIF

Books

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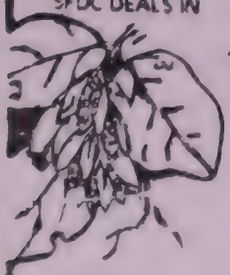

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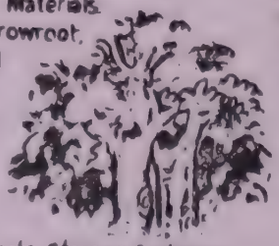

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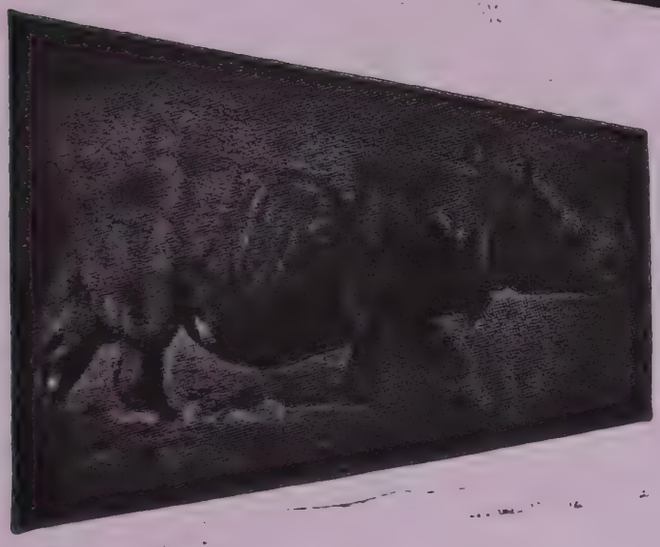

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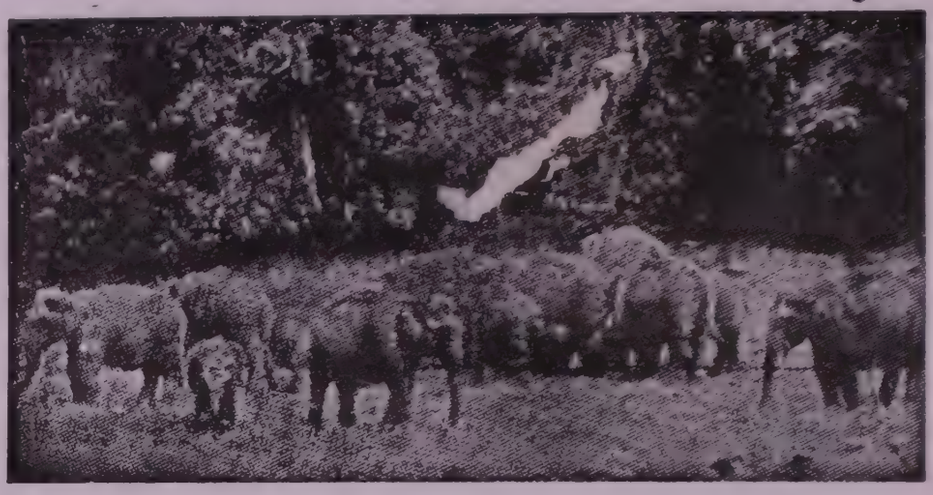

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has taken long strides under the benevolent guidance of our Chairman, Shri Roop Sing Thakur, Hon'ble Forest Minister.

* With complete nationalisation of forest working viz : timber operations, resin tappin etc. both in Government and private forests, there is complete elimination of exploitation labour and private forests owners by the contractors agencies and the incidence of illicit fellin in forests is completely under control.

* Extracts high grade deodar, kail, chil, fir and spruce timber and resin by moder methods produces ISI standard rosin (X to D grades) and non ISI 'B' grade and turpentine oi Production of pale grades registered improvement from 52% to 79%.

* Stocks of timber extracted by Corporation are being supplied towards developmenta works by catering to the requirements of Indian Railways, Director General of Supplies an Disposals, Defence Organisations and other Govt. Indentors. Sale of timber stocks an fuelwood is being organised through well establisbed sale depots conveniently located.

* The annual turnover has registered a significant increase from Rs. 253 lacs, first yea to Rs. 6150 lacs in 1989-90. In order to maximize operational efficiency, following steps hav now been initiated :

(a) Replacement of old fleet of trucks for minimizing transportation time of timber t depots.

(b) Analysis of financial data through computer net-work to ensure prompt and efficien working.

(c) Providing incentives to officers and staff through prompt action on service matters like confirmation, job rotation vis-a-vis career planning including specialised training.

(d) Centralisation of provident fund account of entire staff has been done through computer besides pay-bill centralisation.

MANAGING DIRECTOR

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